metal finishing

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Vol. 6 No. 62 (New Series) FEBRUARY 1960

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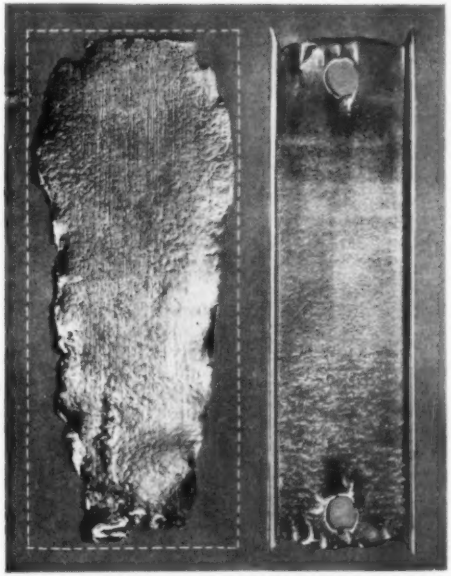

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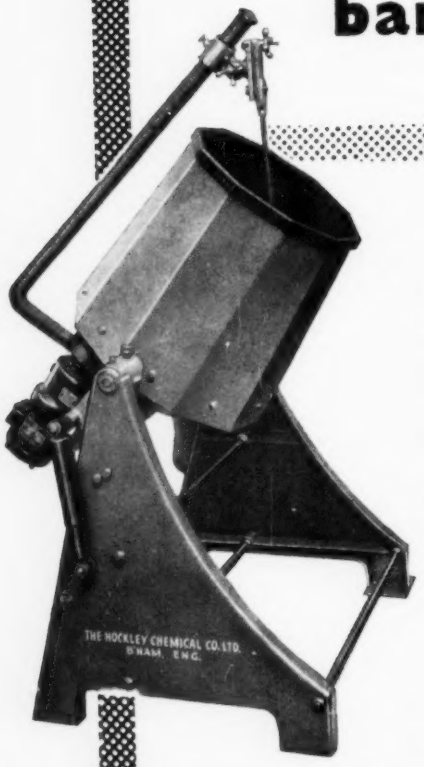

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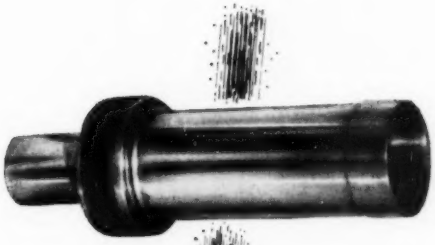

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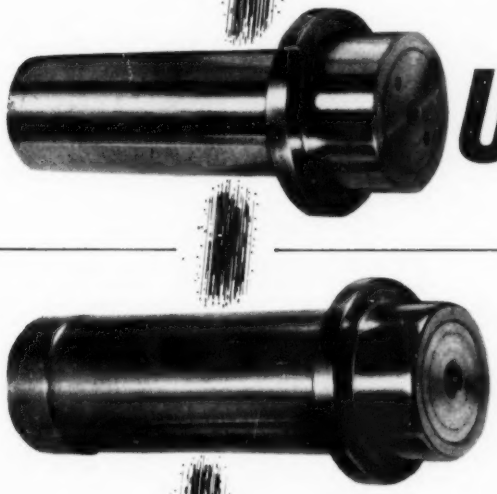

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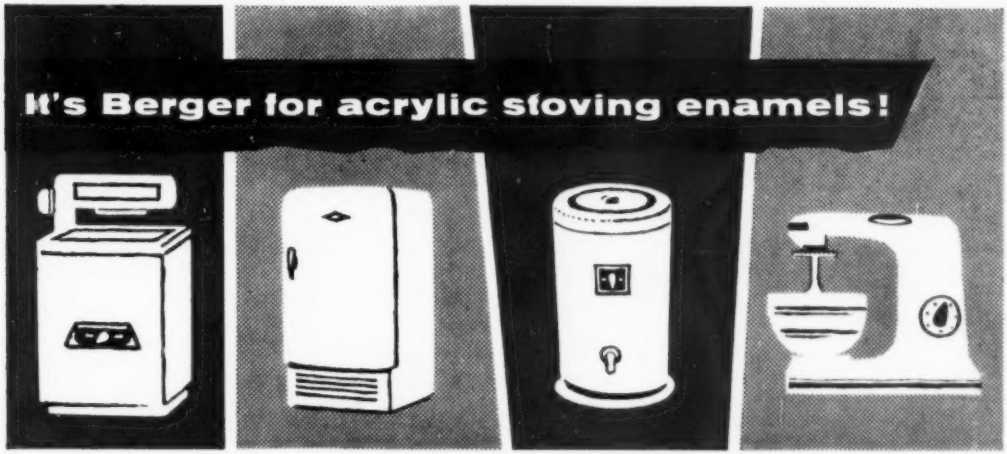

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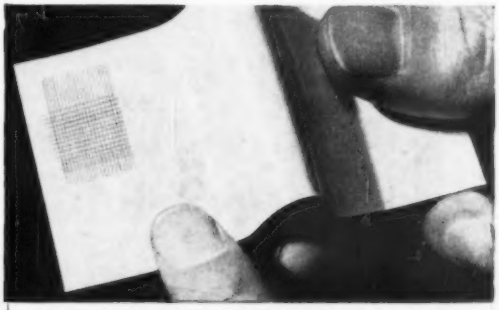

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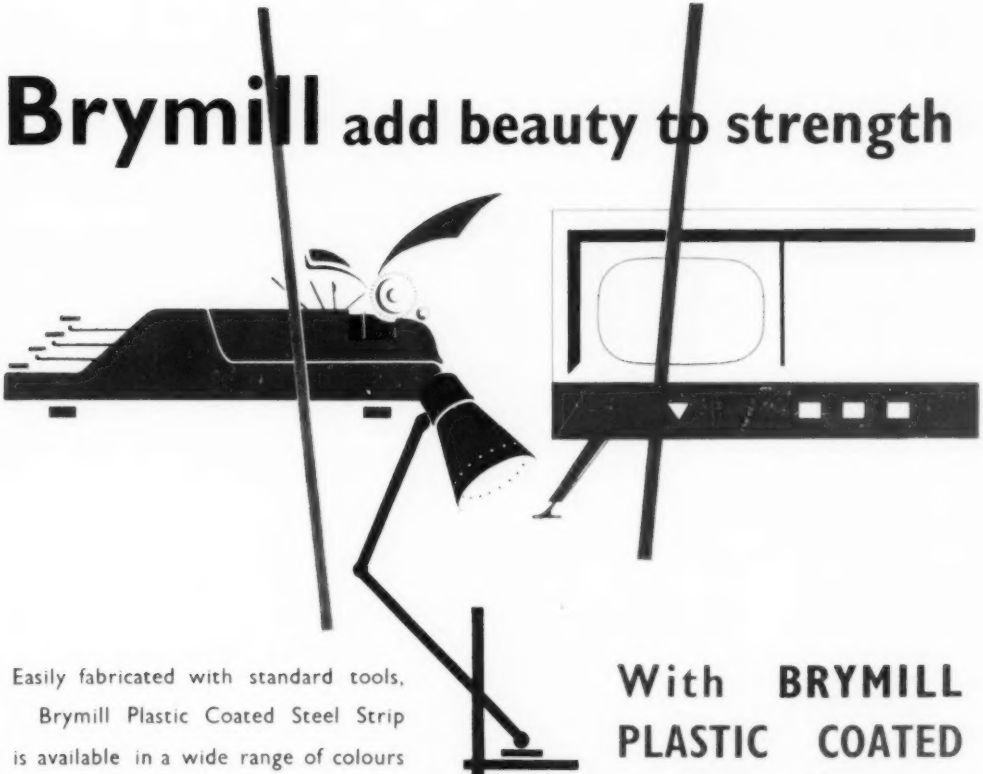

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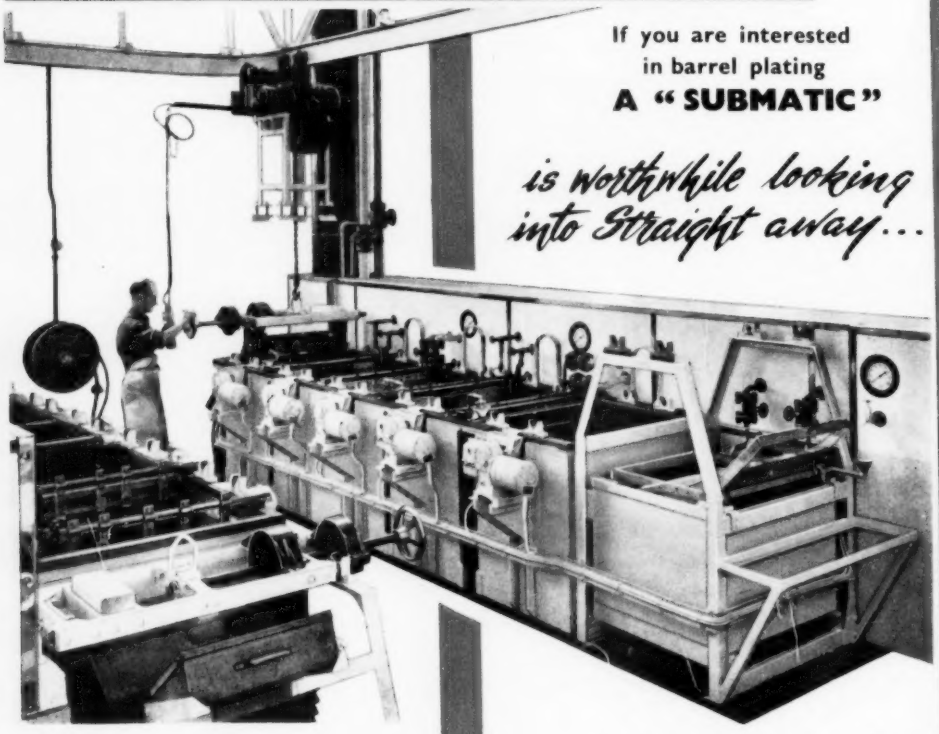

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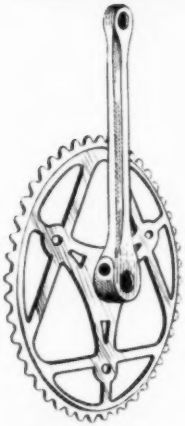

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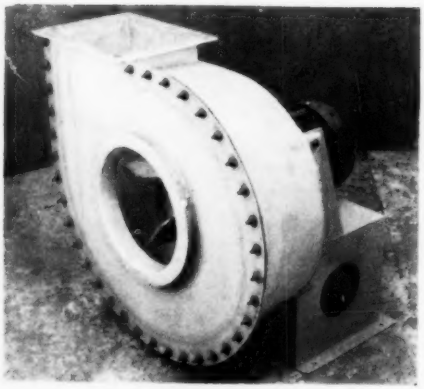

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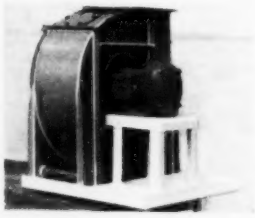

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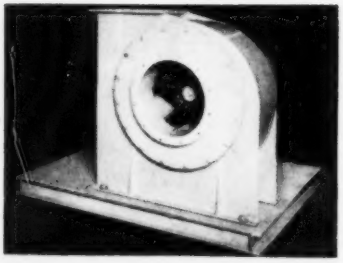

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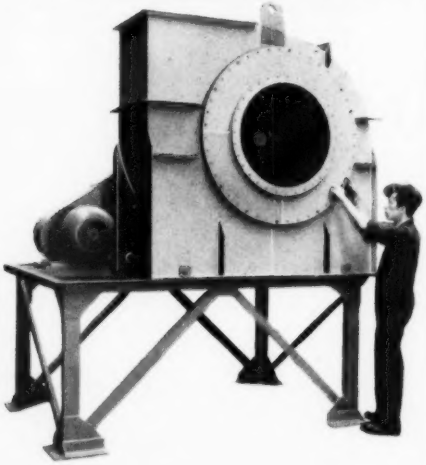

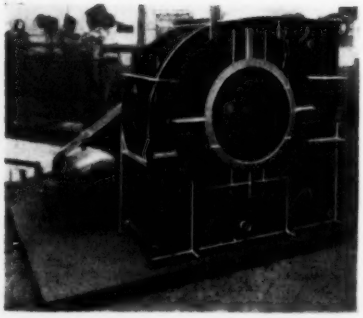

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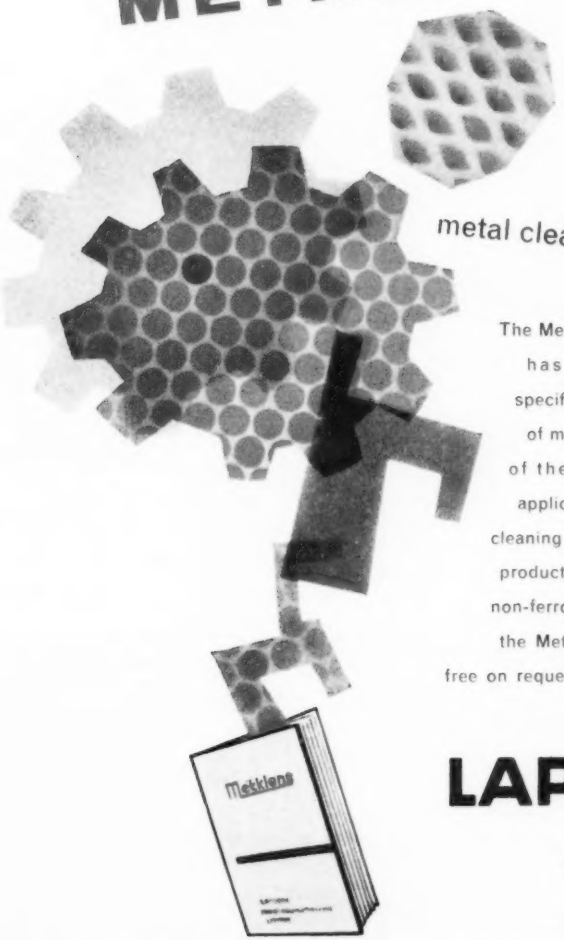

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metal finishing Journal

February, 1960 Vol. 6, No. 62 (New Series)

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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

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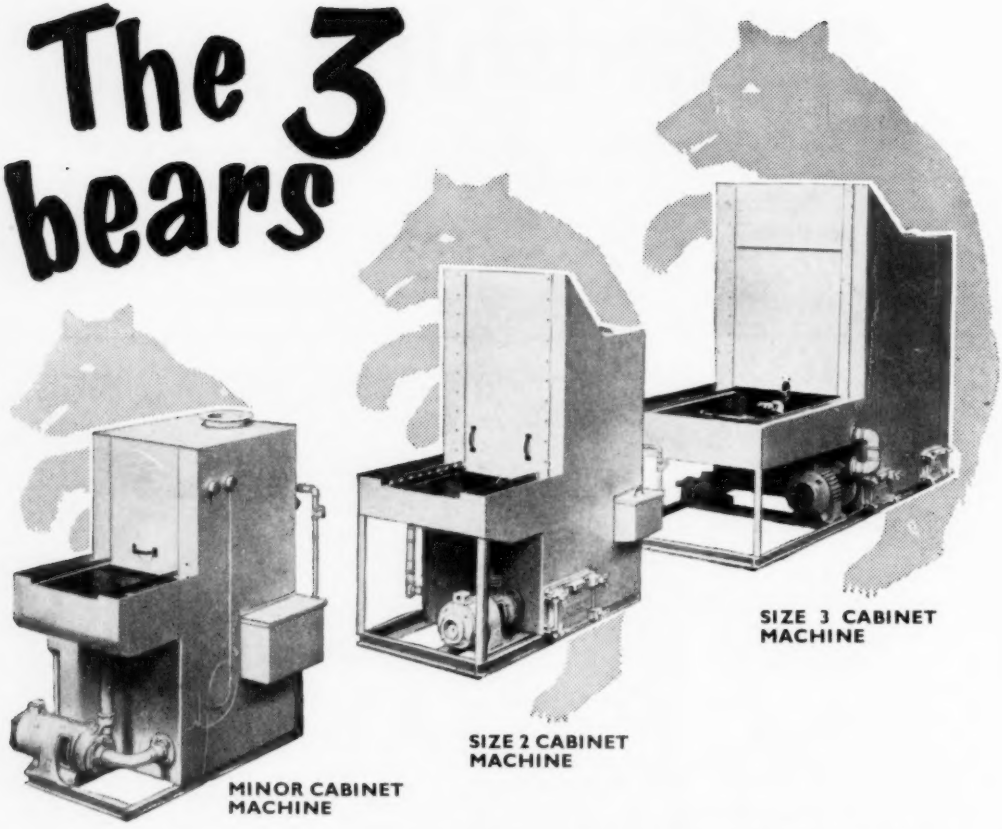
The 3 bears



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WHO SPEAKS FOR CORROSION?

SINCE Adam brought about his banishment from Eden and was condemned to having to earn his bread by the sweat of his brow, the instrument which has been the most effective in ensuring that his heirs should not succeed in evading this penalty is undoubtedly the 2nd Law of Thermodynamics. This inexorable Law, and all the consequences which directly or indirectly derive from it, has meant that no step can be made towards utilizing the resources of the planet for the greater comfort and well being of mankind without the full and proper price being paid in energy expended.

To remove heat from our slings and fizzes in torrid summers, and to add it to our possets and caudles in the frigid depths of winter requires in each case that work be done, and so it is with the materials which are used to construct our dwellings and our tools, our necessities and our luxuries. Iron is violently divorced from its intimate marriage with oxygen under the stern working of the 2nd Law, with carbon as co-respondent in the unnatural condition of the blast furnace. The same iron quietly reunites itself with oxygen, according to the precepts of the same Law when they are once more brought together in some man-made application.

The utilization of metals therefore, involves effort on at least two fronts. One is seeking ever more efficient ways of extracting metals from their naturally occurring compounds, while the other is studying and devising means of preventing the high-energy content of the extracted metal urging it back towards its primary combined state.

It is in this second field of endeavour that this Journal and its readers are most actively engaged, the field of corrosion—its causes, its mechanisms and its prevention. For some years the major platform for the discussion of corrosion science has been provided by the Corrosion Group of the Society of Chemical Industry, with some writings appearing in the journals of certain other learned bodies. Last year came news of the formation, under the sponsorship of a technical journal, of the British Association of Corrosion Engineers, which stated its objects as being generally to promote the dissemination of technical information about corrosion matters and to develop by means of social activities the free interchange of information among members. It hopes to progress in due course towards the establishment and acceptance of qualifications for corrosion engineers and the standardization of techniques of corrosion control.

Now comes the announcement, reported elsewhere in this issue, of the foundation of the Corrosion Science Society, whose aims are cited as being to promote the advance of corrosion science and its application to the solution of practical problems, and to organize meetings of scientifically qualified persons in all fields of corrosion research and practice for the discussion of current work. Sponsors of this Society include some of the most eminent workers in the field of corrosion science in this country.

It could hardly be maintained that the emergence of these new bodies has been in response to a belated recognition of the existence of corrosion study as a branch of science, and it can only be assumed that those responsible for inaugurating the latest body must have been conscious of some need for which provision has not hitherto been made. The fact that the first International Congress on Metallic Corrosion, which is to be held in London in 1961, is to be administered by a special committee and not as might have been expected by the Corrosion Group of the Society of Chemical Industry (a fact which is commented on by "Platelayer" elsewhere in this issue) is perhaps not without significance in this connexion.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

A MYSTERIOUS CONGRESS

A PRELIMINARY announcement has been circulated to the effect that in 1961 the First International Congress on Metallic Corrosion will be held in London. A Congress of this kind will, undoubtedly, fill a real need and should attract a great deal of interest, if it is well organized and covers an adequate field. To encourage the maximum support for a meeting of this kind, however, it is desirable that those invited to participate should know the organization under whose auspices the Congress is being held. Of this there is no indication on the circular, but presumably the Society of Chemical Industry is involved, as the address of the Congress headquarters is the same as that of the Society's offices. The Society has a very active and internationally known Corrosion Group, yet there is no evidence that the Group is a sponsor of the Congress. If this is indeed the case, it is a great pity.

Another strange feature is that, although no details of the Congress programme are given, applications for membership are invited, accompanied by a remittance for £5. Most potential members will almost certainly like to know a little more about what they are going to get for their money before they subscribe, especially as the event is still such a long time ahead.

In any case, there should be more co-ordination with existing interested bodies before an important event such as this is announced.

SPONSORED RESEARCH

ONE of the great differences between research organization in the United States and in Britain is the relatively small part played here by sponsored research in independent profit or non-profit making organization. There are only four such research institutes here, as compared with a much larger number across the Atlantic, only some 0.1 percent of the total amount spent on research and development being in the form of sponsored work, as compared with 1.5 per cent in the U.S.A. On the other hand, we do have the Department of Scientific and Industrial Research with its 49 co-operative research associations which has no American counterpart ; in fact combined research by competitive companies seems to the American mind, a contradiction in terms. The fact that it works here may well be considered an indictment of the attitude of many of our industries towards research, *i.e.*, it is not of such great importance as to merit a high degree of secrecy so far as competitors are concerned. It is, therefore, not without significance, as was pointed out by Dr. F. N. Woodward, of the Arthur D. Little Research Institute in Scotland, that chemicals, pharmaceuticals and oil, the three industries in Britain with the greatest reliance upon scientific research, are without research associations.

There is no doubt that there is considerable scope for more sponsored research here, if only some effective means could be arranged to bring its advantages home to many firms which could benefit by it. It might not by such a bad idea if the existing institutes could co-operate in organizing a joint conference at which clients and potential clients could be encouraged to get together and exchange views and experiences.

SHOW BOATS

WE tend to think of the U.S.A. as a country with a relatively small coast line, and hence not one where boating would be particularly popular. It is, therefore, surprising to find that America has some 8 million recreational boats. Interest in boats is also increasing rapidly here, orders received at the recent Boat Show being, in the case of some firms, as much as three times greater than the previous year.

The relevance of this to the paint industry is that boat owners in the U.S.A. are buying some 10 million gallons of paint and varnish to keep their craft in trim. Boats need a lot of painting and this is evidently a market to be watched.

SOME CHROME

SOME manufacturers issue curious instructions on the treatment and cleaning of their plated products. However, one of the strangest is that contained in a leaflet presented to purchasers of a French electric grill on sale in this country which contains the following sentence :—

> "The body of the 'Roto-Grill' being chromed, *water must not be used.* Rub with a dry soft cloth, after use, and whilst the chrome parts are still warm, dry them."

While we have seen some pretty poor chromium plating in our time, we have yet to find any which must not be allowed to get wet !

ZINC COATINGS ON IRON AND STEEL

4 — Finishes for Zinc Coatings

A Survey

by A. K. PARKER, M.A.
in collaboration with the Zinc Development Association

(*Continued from page* 453, *December* 1959 *issue*)

ALTHOUGH zinc takes on a pleasant grey patina when it is exposed to the atmosphere—the hot-dip galvanized pylons of the British Electricity Authority are a familiar rural example—this does not fit it in with everybody's scheme of decoration. Frequently, therefore, zinc-coated articles have to be painted for decorative reasons, or to camouflage them, if they form part of a military installation.

Paint coatings are applied direct to iron and steelwork to protect it against corrosion. Hence a painted zinc coating on steel will afford extra protection, and, in fact, it is found in practice that the life of a zinc-plus-paint protective system is longer than the sum of the lives of an equivalent paint coating and an equivalent zinc coating. In other words painted zinc coatings form a single protective system, in which each component complements the corrosion resistance of the other.

Where conditions are only mildly corrosive, the life of the zinc coating may be as long as that expected of the article itself so that further protection is often superfluous. In severe industrial atmospheres, however, the combination of zinc coating plus paint coating can, with very little attention, give complete protection over a long period, often with less expenditure than if the paint had been used alone. This is because suitable paint coatings last longer when applied to properly prepared zinc coatings than when applied directly to steelwork — hence less frequent repainting is necessary — and also because the repainting is itself simplified as less preparation is required. Figures for the comparative costs of typical protective systems and their subsequent upkeep have recently been published [1-4].

Occasionally, the need to provide electrical insulation is a further reason for applying an organic finish over a zinc coating. Such cases are nearly all confined to the telecommunications industry.

Chromate Passivation Treatment on Zinc Coatings

The simplest type of finish applicable to fresh zinc surfaces to provide extra corrosion resistance is a chromate passivation treatment. It is equally suitable for use on hot-dip galvanized, zinc-sprayed, zinc-plated and sherardized articles.

The usual treatment consists simply in cleaning the articles and then dipping them in a chromic-acid solution at about 60 to 70°F., followed by rinsing in cold fresh water and drying in a current of warm air. The chromate film should have a greenish iridescent or greenish-yellow iridescent appearance free from bare patches, and should be adherent. Ministry of Supply Specification D.T.D. 923A[5] gives details of tests for the adequacy and effectiveness of the coating and frequently forms the basis of contracts involving chromate passivation treatement.

Chromate passivation treatment prevents the formation of " white rust," the bulky white deposit which often forms on fresh zinc surfaces allowed to stand under humid conditions (*see* chap. 3). It is always to be recommended for zinc-coated components intended for service in the tropics, where high humidities are to be expected. The chromate film is not an insulator, so it may be applied to electrical components before assembly without interfering with the electrical contact between them. Dry heat is damaging to the

Fig. 24.—*Typical process flow sheet for operating the "Cronak" chromating process of the Imperial Smelting Corporation Ltd.*

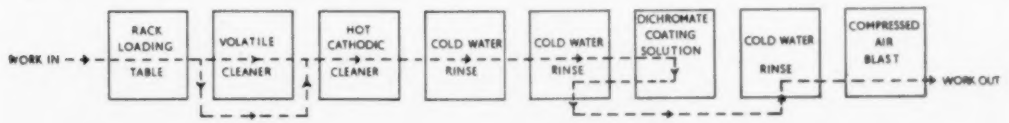

Fig. 25.—The weathered galvanized sheeting on the Empress Hall, Earls Court has been painted with calcium plumbate.

Courtesy Associated Lead Manufacturers Ltd.

chromate film, so it is not suitable for use on a component of which part is to be stoved enamelled at a later stage in manufacture.

If the prevention of "white rust" is the only requirement, an even simpler form of chromate dip has been developed by the British Non-Ferrous Metals Research Association.[6] This consists in dipping the zinc-coated sheet in an acidified 1 per cent. solution of sodium dichromate for 30 sec. at room temperature or slightly above it.

Zinc Coatings as Bases for Organic Finishes

The matt surfaces obtained by zinc spraying or sherardizing form ideal surfaces for painting and the ordinary types of organic finish will adhere satisfactorily to them, without the need for any special preparation. However, on hot-dip galvanized or zinc-plated (especially bright-zinc) coatings, it is necessary either to use special primers or to prepare the surface before the paint is applied. This is partly because these types of zinc coating are too smooth to provide a mechanical key for the paint or lacquer and partly because the paint appears to react with the unprepared zinc surface to form a compound with weak mechanical properties, though the mechanism of this reaction is uncertain.

The simplest base for a paint system on freshly hot-dip galvanized or zinc-plated steel is a coat of primer pigmented with calcium plumbate. No pretreatment is required apart from a wash with white spirit to remove grease. Outdoor exposure tests have amply demonstrated the excellent adhesion possessed by this type of primer when applied to both new and weathered galvanized surfaces.[7,8] These results have been confirmed in many practical applications,[7,9] although the reason for the good adhesion of calcium plumbate paint is still not understood.[10]

The ordinary type of calcium plumbate paint

Fig. 26.—The new extension to the boiler shop of Guest Keen Iron and Steel Co. Cardiff, was painted with calcium plumbate on erection.

Courtesy Associated Lead Manufacturers Ltd.

has a linseed-oil vehicle which takes 24 hours or more to dry. While this comparatively long drying-time is acceptable for galvanized articles such as window frames which are painted on site, it may prove inconvenient for goods painted in the factory. To overcome this difficulty, stoving primers pigmented with calcium plumbate are now being developed and tested.[7]

Until the development of paints pigmented with calcium plumbate, the most common pre-treatment was the immersion of the galvanized or zinc-plated article in an etching solution containing phosphoric acid and zinc salts together with accelerating agents to promote rapid reaction leading to the formation of uniform, fine-grained and strongly adherent phosphate films on the work. The solutions are usually used hot and are applied by dipping or spraying ; special cold solutions may also be brushed on. Several proprietary solutions are marketed and full operating details are provided by the makers(*). The work should be washed in water, both before and after phosphate treatment.

The chromate passivation treatment referred to in the previous section also gives satisfactory results when used as a basis for an organic finish.

Hot-dip galvanized surfaces are often prepared for painting by being allowed to weather in the open. The time taken for this to be effective varies with the aggressiveness of the atmosphere and a satisfactory surface may take anything from a few weeks to a year to form. Care should therefore be exercised in deciding whether a surface is adequately weathered before brushing off the loose corrosion product and painting it.

In recent years, certain special paints called " etch primers " or " wash primers " have become available which still adhere directly to freshly galvanized or zinc-plated surfaces. These are said to form an inorganic film, which provides adhesion, and an organic film, which forms the coating, so that they act as both primers and etching solutions. [11] Most etch primers are based on polyvinyl-butyral and contain chromates and phosphoric acid. They should be applied as a thin coating and the second coat should be applied soon after the primer is dry. When etch primers are used, the choice of second coat is somewhat restricted and the makers of the primer should be asked to recommend a suitable one. Because some types of etch primer have only a short shelf life, they are supplied in two parts which should be mixed just before use. For the best protection an ordinary primer should follow ; for indoor use, it can be omitted.

Suitable Organic Finishes for Use on Zinc Coatings

In the telecommunications industry, a lacquer finish is frequently applied to matt zinc-plated components[12]. This serves to protect them against " white rust " and against finger-marking in handling during assembly, as well as delaying deterioration in service. Thin coatings of lacquer are usually applied to small parts by dipping, though heavier parts and parts which will need to withstand heavy handling are often given an additional spray coating. Two types of lacquer in common use are a high-viscosity cotton formulation containing 12.5 to 13.5 per cent. solids and a special cellulose/glyptal-resin formulation containing 22 to 27 per cent. solids.

Paints pigmented with calcium plumbate and employing linseed-oil vehicles can be applied to give a fairly heavy coat directly on freshly galvanized or zinc-plated surfaces and so may be used on their own where only a one-coat system is required. Any standard weather-resisting or gloss paint may be used on top of the calcium-plumbate primer and sometimes a second coat of the calcium-plumbate paint is applied instead of a separate finishing coat.[7]

Some recommendations on the composition of paint systems to be applied over zinc-coated steelwork are made by the British Standards Institution.[13] Two-coat paint systems applied over a zinc coating are classed as Grade I protective schemes suitable for use on surfaces fully exposed outdoors under severe conditions, as in industrial atmospheres. For the finishing coat, most good paints based on a drying oil, oleo-resinous, synthetic, bituminous or other suitable medium are preferred, though it is, of course, important that a bituminous paint should contain no acidic phenolic constituents.

Performance tests [14] on the behaviour of painted hot-dip galvanized window frames in very humid conditions in a sugar-beet factory and in a highly polluted atmosphere in a gas works have led to the conclusion that the greatest single factor to be considered in choosing a protective paint system for use on zinc coatings is its impermeability to moisture. In this respect modern synthetic vehicles are perhaps better than those based on oil and chlorinated rubber; bituminous paints are also to be recommended.

A useful published table[15] lists all the more important modern and standard types of paint and compares their main chemical, physical and mechanical properties on a strictly relative scale of values. A table of this sort can only give general guidance in selecting a suitable paint to meet specific requirements as paints of the same type can show considerable variations in film properties on account of differences in formulation.

The use of etch primers considerably restricts the choice of paint for subsequent coats and silicate paints, some bituminous paints, and some paints

*Parkerizing, Walterizing, Bonderizing, Lithodizing and Granodizing are a few of the trade names.

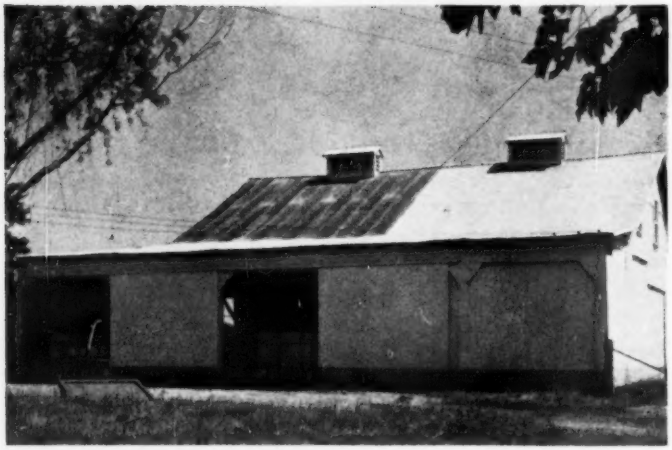

Fig. 27.—The roof in this picture was photographed five years after painting. The section of the left on the picture was painted with an aluminium paint and that on the right with a zinc-rich paint.

and lacquers based on ethyl cellulose, nitrocellulose acetobutyrate, hard resins, styrenated alkyd resins, cellulose plasticized phenolic resins and polyurethane resins are best avoided in these circumstances.[15]

It has been stated earlier that the slightly rough matt surface on zinc-sprayed and sherardized articles forms an excellent basis for paint. If at least two coats are to be applied, the first one should be well thinned so that it can penetrate into the pores of the coating and the second one should be fairly viscous so as to ensure that it covers the "peaks" of the rough surface. It is especially important to exclude water when painting as it may otherwise lodge in the pores and corrode the zinc coating underneath the paint.

Repairing and Patching Zinc-coated Surfaces

When articles are manufactured from zinc-coated sheet, or from steel sections which are zinc coated before erection, there will be a number of uncoated edges, welds and rivets. Also, parts of the zinc coating may have suffered mechanical damage during fabrication, transport, and erection. Zinc-rich paints of the types described on pages 321-2 (Sept. issue) are the ideal materials with which to fill in the gaps in the zinc coating and so complete the protective layer over the whole surface of the fabricated structure. Because these paints give a dry film containing about 95 per cent. zinc dust, they protect the underlying steelwork sacrificially in the same way as zinc coatings applied by hot-dip galvanizing, spraying, electroplating and sherardizing.

On account of the simplicity with which zinc-rich paints can usually be applied to structures in service, they are ideal, too, for reconditioning unpainted zinc coatings nearing the end of their useful life. For reasons both of protection and economy, such reconditioning should be undertaken before more than 5 per cent. of the surface shows rust. Any loosely adherent rust should be removed by light wire brushing before applying the zinc-rich paint. Tests on Dutch high-tension towers[15] have shown that a two-coat system has advantages, a thin coat being applied first, followed by a heavier coat after an interval of at least two days. A structure reconditioned in this way acquires a uniform grey colour after 2 to 3 months, when the zinc dust has taken on the same colour as the surrounding weathered zinc surface.

(To be continued)

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"CONFIDENCE IN PLATING"

FOLLOWING the recent announcement of the new British Standard for electroplating and the Mond Nickel Company's labelling scheme, Mond are holding an exhibition and conference under the above title at the Engineering Centre, Birmingham, from February 23 to 25. Full details are available from the company.

"HEAT-PLATING"

A New Process for the Deposition of Tungsten Carbide and Nickel, and for Hardfacing

A NEW " heat-plating " process, developed by Todco of Whitier, California, U.S.A., under the generic title of " Pyro-Plates " is now in use in the U.S.A. by Metallurgical Consultants Inc., Maywood, California. Three processes are available, " Pyro-Tung " for the deposition of tungsten carbide, " Pyro-Plate " for nickel and " Nikl-Kase," a hardening process. The oxygen-containing compounds of nickel and cobalt used in these processes are applied to metals and when reduced form a low-melting-point alloy plate metallurgically bonded to and diffused into the surface to become an integral part of the base metal. Unlike electrolytic processes, adhesion is not involved in the process as the substrate becomes a mutual solid-solution nickel alloy which cannot rupture.

These plating and hardfacing compounds are applicable to all ferrous metals, including cast iron, stainless and high-alloy steels and copper, to produce surface plates, diffusion layer cases and hardfacings exhibiting, it is claimed, a superior resistance to oxidation, corrosion and to abrasion in a degree adjustable and economically suited to specific applications.

Utilizing fast, clean mass-production techniques, paint or slurry, thinned to desired consistency with Pyro-Plate No. 1000 Thinner may be applied by dipping, spatula, brush, spraying with paint spray gun or by plastic squeeze bottle, or by flame spraying. Special equipment, special surface preparation and masking are eliminated. Conventional degreasing, acid pickling, grit or vapour blast provide the clean metal surface necessary for a good diffusion layer. The self-fluxing compositions in a quick-drying suspension have a high wetting action, good adherence and are readily applied to interiors where many plating methods are difficult or impossible.

Reduction to a plate or hardfacing is accomplished by heating in a reducing atmosphere in the range from 1659 F to 2050 F. (900 to 1120 C.). Holding at temperature is unnecessary as fusion occurs when a specified minimum heat is reached. Thus, the short heating cycle, standard brazing temperatures, adaptability to continuous-type furnaces and processing as an integral part of other heat treatment make possible economical techniques.

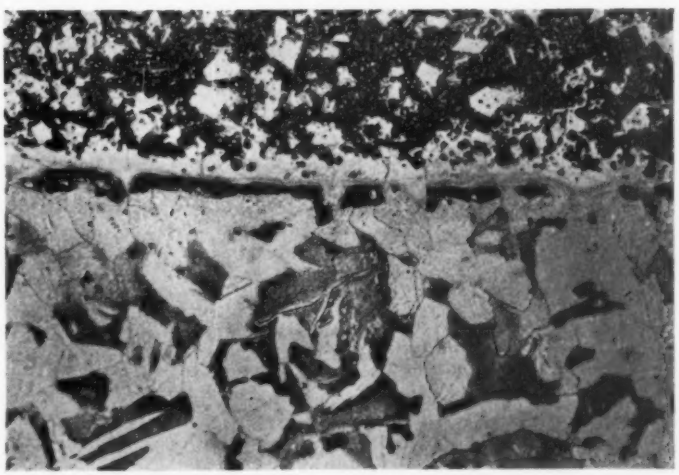


Fig. 1.—(x 500). Photomicrograph of Pyro-Tung plate on 1020 steel shows in top layer large and finely divided particles of tungsten carbide (white) held in nickel-iron (black) matrix. White ternary layer beneath is iron, nickel, carbon, tungsten alloy mutual solution of plate and base metal ; black line, a complex of unidentified phase. Bottom layer is steel substrate.

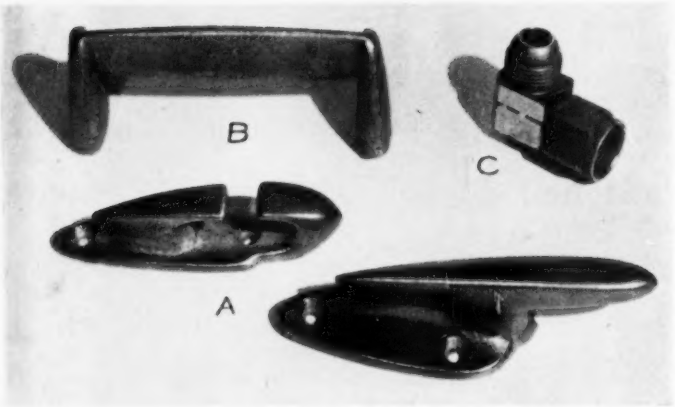


Fig. 2.—Typical articles plated with Pyro-Plate nickel plate for resistance to corrosion.
A. & B. Marine fittings of cast iron, as cast, after being sand rolled and plated.
C. Aircraft fitting of steel as machined and plated. Part is plated inside and out including both internal and external threads.

Pyro-Tung

Pyro-Tung tungsten-carbide plate contains approximately 80 per cent. by weight of crystalline tungsten carbide interspersed in an alloy matrix of nickel and the base metal to which it is fused. Very finely divided tungsten carbide in the composition dissolves in the molten alloy at a reducing temperature of 2050° F. (1120° C.) and, on cooling, precipitates as crystals to form a plate extremely resistant to abrasion. The wear resistance of Pyro-Tung plate is said to exceed that of the hardest steels, this factor being attributable to the finely dispersed carbide crystals which have a hardness of 1850Knoop$_{100}$ or about 85Rc and are held in a matrix of approximately 60Rc. Thus, usual hardness tests are not indicative of the anti-abrasion potentials of the plate.

Applied by brush, spray, or dipping and reduced, plates 0.0005 in. to 0.005 in. thick may be achieved, but thin plates must be supported by a hard substrate in some applications. Such hardening of the substrate may be done as an integral part of plate application or by subsequent heat treatment without adverse result. Pyro-Tung as applied has a hardness of 55-60Rc but subsequent hardening can increase this to 65-70Rc. Applicable to any metal, other than cast iron, whose melting point is above 2050° F. (1120° C.) mutual solution of the plate and base metal produces an alloy layer in the substrate approximately equal to the plate in thickness. Parts plated and ground to original dimensions exhibit the anti-abrasion qualities of the plate itself.

The nickel matrix of Pyro-Tung lends ductility and flexibility to the plate which cannot be achieved in other wear-resistant products. The plate may be ground, micro-polished, post-formed and welded. It has high hot hardness, resistance to abrasion, erosion and galling. Copper brazing and Pyro-Tung application may be combined.

Pyro-Plate Nickel

This composition is applied in one or more coats to build a plate from 0.0005 to 0.003 in. thick on ferrous metal and copper surfaces which are non-porous. The nickel-phosphorous alloy, when reduced in hydrogen or disassociated ammonia at 1650 to 2200° F. (900 to 1205° C.), has a bright, nickel colour and provides a corrosion-resistant plate equal to or, in some cases, better than pure nickel.

Exceptional corrosion resistance is attained by careful application of the composition on to an absolutely clean surface in hydrogen. Such a plate has greatly extended life over platings of zinc or cadmium. Rough, porous surfaces are more difficult to make "corrosion proof" but the metallurgical bond and self-quenching action of this nickel composition make corrosion inconsequential. Self-quenching occurs where minute spot corrosion starts. Due to polarization, the insoluble nature of the corrosion products and the fact that the plate cannot lift or peel, rusting is quickly inhibited even where the plate is deeply scratched.

Pyro-Plate nickel is unaffected by a wide array of corrosive media including 5 per cent. hydrochloric and sulphuric acids, mild organic acids, organic chlorides, alkaline metal and alkaline earth chlorides, steam and many others.

Applied to cast iron and porous metals, Pyro-Plate nickel is completely infiltrated into the substrate to form a hard, nickel-iron diffusion layer highly resistant to oxidation and corrosion. This diffusion layer case is from 0.003 to 0.005 in. deep and its increased hardness improves abrasion resistance. There is no build-up or dimensional change in the external surface. The excellent anti-oxidation properties result from nickel infiltration along the grain boundaries and "plating"

(*Continued in page* 54)

Fundamental Investigations into THE POROSITY OF PLATED COATINGS

Some Results obtained by the U.S. NATIONAL BUREAU OF STANDARDS

THE U.S. National Bureau of Standards has recently been investigating the causes, nature, and effect of porosity in plated coatings for the American Electroplaters' Society, because the protecting value of a plated coating on metal is dependent, to a large extent, on the exclusion of pores and other flaws in the coating.

As part of this programme, several different aspects of porosity have been studied including the development of an improved technique to study porosity of metallic electroplated coatings with a microscope, evaluation of the sensitivity of the ferroxyl test — one of the generally accepted methods of detecting porosity — and determination of the influence of gas on pore formation.

Further knowledge of these phases of electroplating and a satisfactory method of measuring the porosity should be of value both to the plating industry and to the science of electroplating. A continuous protective coating is particularly important in the field of aeronautics, where the metals used for jet engines and other high-temperature components must withstand great changes in temperature.

Microscope Detection Method

Although much research has been directed toward pore detection and elimination, methods of examining pores on metallic coatings with microscopes have received little attention because most pores have diameters too small for adequate sectioning. Even if a pore is sectioned properly, the contours may be distorted by polishing and etching. So far, attempts to cut an entire pore parallel to its axis have been unsuccessful, so that a dot or oval is all that is seen.

" Parallel sectioning," a technique developed by *F. Ogburn*, and *D. W. Ernst*, research associates of the American Electroplaters' Society, involves polishing off some of the coating *perpendicular* to the axis of the pore and parallel to the basis metal. When the cut section is studied under a microscope, the pore will appear as a small dot which can easily be seen at 400 magnification if the pore is larger than 0.05 mil in diameter. To ensure that the dot is not a surface defect introduced during polishing, successive layers are removed and examined until the underlying metal is reached. If the dot is a pore, it will reappear consistently at the same spot. A pantograph arrangement is used to relocate the exact position of the pore after successive removal of each layer.

With this technique, the size and shape of pores or other defects that are difficult to cross-section can be determined and the damaging effects of atmospheric corrosion can be further studied.

Four types of pore defects were found in these studies : Pits (dead-end pores), cavities (enclosed pores), continuous pores, and bridged-over pores. The relative frequency of these four types has not been determined.

Sensitivity of Ferroxyl Test

The best known porosity test for nickel coatings on steel is the ferroxyl test in which a solution of sodium chloride and potassium ferricyanide applied to the coating produces a blue spot where the basis metal is exposed. Because the reagent was found to attack the nickel coating and produce pores, this test has been modified to eliminate any contact between the ferricyanide and nickel. However, since the overall sensitivity was not known, experiments were conducted by the Bureau to determine the efficiency of the method.

Test specimens were prepared by plating steel sheets with gold on one side. The coated specimens were then tested with the modified ferroxyl test (solution of sodium chloride-potassium ferricyanide). Next the basis metal was dissolved by an acid solution, leaving the coating. This gold foil was photographed by placing it on a photographic film and exposing to light. The resulting photographic record of the porosity, supplemented with measurements of pore size obtained by microscopic examination, were compared, spot by spot, with the pattern produced by the ferroxyl test.

From this experiment, it was found that the sensitivity of the ferroxyl test decreased as the

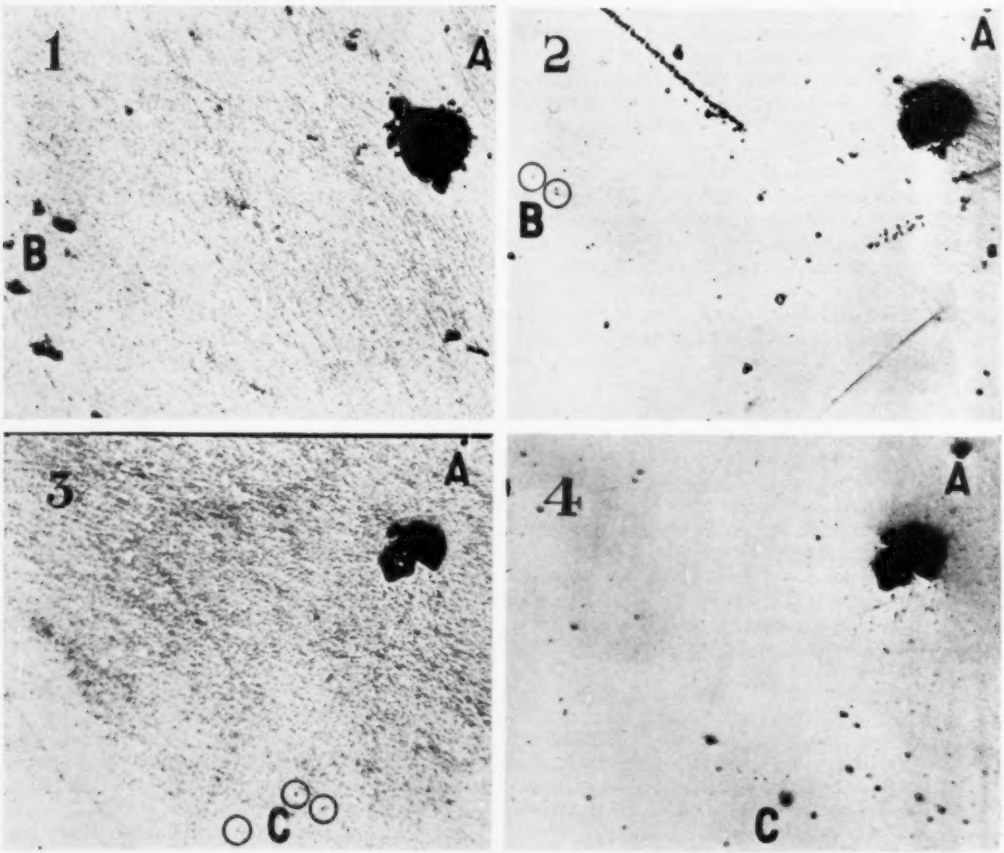
pore size decreased. Virtually all pores 0.5 mil or more in diameter were detected by the ferroxyl test while very few of the pores less than 0.1 mil in diameter were detected. Since smaller pores are more numerous than larger pores, it is evident that the ferroxyl test has rather severe limitations.

Influence of Gas on Porosity

Several initiators of pore formation have been suggested. These are : Inclusions in the basis metal; surface contours and other discontinuities of the basis metal; foreign matter in the bath that settles on the cathode; and initial sites of nucleation on the basis metal which build up without filling all intervening spaces. No matter which of these — or other factors — initiates a pore, once it has been started, subsequent deposition should bridge over it. The fact that this bridging over does not always continue with deposit build-up may be explained by gas discharge or bubble formation. From studies using parallel sectioning techniques, it seems likely that almost all pores follow the normal tendency to bridge over ; those that are prevented from closing up because of gas accumulation give the deposit its resulting porosity.

One factor contributing to the formation of pores involves the growth of a deposit around a gas bubble. To study the effect of gas on porosity, a cell was developed with a transparent bottom that facilitates observation of metal deposition. This cell has a concentric cylindrical electrode system so that the cathode (*i.e.*, the metal being

Fig. 1.—(*x* 400). *Micrograph showing three of the different types of pores found in electrodeposited coatings during investigations at the U.S. National Bureau of Standards. The continuous pore (A) is larger near the basic metal than at the surface ; the dead-end pore (B) extends about one-third of the way through the deposit ; and the bridged-over pore (C) goes from the basic metal into the deposit. (Successively polished layers are shown in upper left, upper right, lower left, and lower right).*



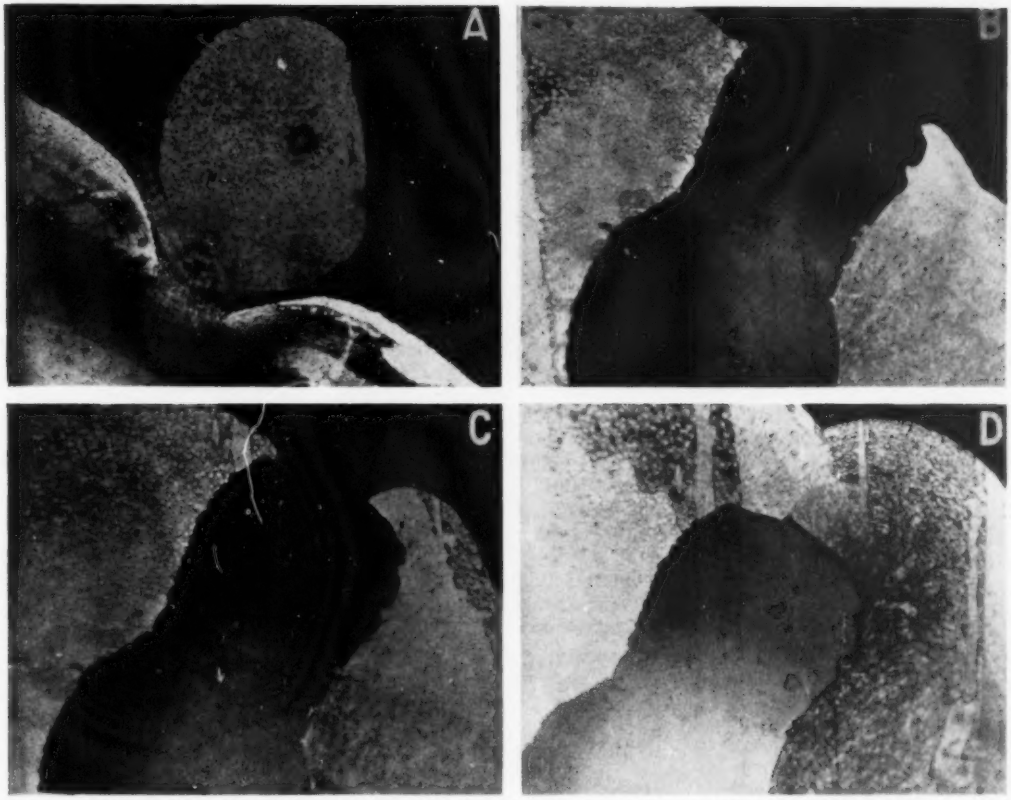


Fig. 2.—(x 200). Formation of pores due to gas bubbles. The micrographs illustrate initiation of the bubble (A), partial deposit growth around bubble (B and C), and complete covering over (D).

plated) is at the centre of the system, pressed down on the thin cell bottom. Deposition forming around the periphery of the cathode can be observed though this transparent bottom. When the current density is increased until hydrogen evolves, and then decreased slightly, hydrogen bubbles remain attached to the plated surface. If the cell is operated at a low current density, the deposit thickens at a uniform rate with few visible defects. At high current densities hydrogen, evolved in great excess, produces a rough deposit that has poor adherence.

The relative rates of hydrogen discharge and metal deposition were found to determine whether a bubble is covered over by the deposit or enlarges itself. When a gas bubble is large enough to break way from the deposit, it leaves some gas in the pore formed by the deposit growing around the bubble. This gas effectively blocks the electrolyte from entering the pore and so prevents the deposit from forming across the pore opening. Although this experimental procedure differs from actual industrial plating conditions in several ways, observations seem to indicate that the pore growth mechanism it demonstrates is applicable on a broader scale.

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FORMATION OF CORROSION SCIENCE SOCIETY

CORROSION topics are discussed by many institutes and societies in Britain, at meetings more often than not consisting of lectures and symposia on established matters. However, there exists no independent organization bringing together scientists interested in the progress and practice of the science and technology of corrosion and its prevention, for the discussion of current work.

It is believed that an independent Society, consisting only of professional scientists and technologists working in the corrosion field, would be particularly well able to promote the advance of corrosion science. Meetings of limited size, at regular but not too frequent intervals, have proved very attractive to many people for the informed discussion — not necessarily accompanied by publication — of their current special subjects : examples are, in Europe, the meetings of the CITCE and in the U.S.A., those of the Gordon Conference Organization.

The Corrosion Science Society is therefore being formed with the following immediate aims :

To promote the advance of corrosion science and its application to the solution of practical problems.

To organize meetings — personal, local, national and international — of scientifically qualified persons interested in all fields of corrosion and corrosion-protection research and practice, for the discussion of current work.

To co-operate with all other professional individuals, societies and institutes, British and foreign, with interests in the corrosion field.

The first meeting will be held on April 4-5, 1960, at Battersea College of Technology, London. Stress-corrosion cracking, the corrosion and protection of aluminium, cathodic protection, electrode processes and high-temperature corrosion and oxidation will be among subjects to be discussed on the basis of a series of talks by workers at present active in these fields, including C. Edeleanu, J. G. Hines, T. P. Hoar, J. E. O. Mayne, N. F. Mott, E. C. Potter and L. L. Shreir. All interested should write to either Dr. T. P. Hoar, Department of Metallurgy, Pembroke Street, Cambridge or Dr. L. L. Schreir, Battersea College of Technology, London, S.W.11.

Heat Plating

(*Continued from page* 50)

of the individual grains to alleviate oxidation-induced surface cracking and flaking. Such surface protection has been markedly demonstrated in cast-iron glass moulds, their life being extended more than 75 per cent. Plated mild-steel hot-work dies, tested over an extended period at 1200° F. (650° C.) in an open air furnace show anti-oxidation qualities equal to stainless-steel dies costing four times more, as well as better heat transfer characteristics.

Among other advantages are ease of application to interior cavities, plating of threads and sharp edges without build up, ductility permitting post-forming, drawing and bending of the base metal and excellent weldability resulting in non-corrosive joints. Application may be an integral part of a heat-treating operation and the plate subsequently precipitation hardened if desired from 40Rc as applied to 60-65Rc. Corrosion- and oxidation-resistance properties allow substitution for expensive stainless steels of mild and alloy steels having a wider range of physical properties.

Nikl-Kase

A suspension of hardfacing alloy in paste form, Nikl-Kase paste may be thinned to a slurry for application from a plastic squeeze bottle where thick, hardfacing deposits to resist abrasion are specified. Niki-Kase is available in hardnesses of 40, 50 and 60Rc. Nikl-Kase 60, about 60Rc, is hard enough for smear-free lapping and grinding ; Nikl-Kase 40 and 50 may be machined.

Reduced at 1870° F. to 1900° F. (1020 to 1038° C.) for hardface coatings up to $\frac{1}{8}$in. thick, it relies on extremely hard chromium borides for its excellent abrasion resistance. This may be substantially varied through the addition of up to 50 per cent. by weight of tungsten carbide.

Nikl-Kase hardfacing spray powders available in hardnesses of 40, 50 and 60Rc further increase the versatility of these coatings. Such powders may be sprinkled into the moist surface of Pyro-Plate nickel and, when reduced, will produce thin, corrosion-resistant hardfacing layers on the inside surfaces of various articles such as valves, pumps, etc., where application of other hardfacings is difficult, or impossible.

These hardfacings may be hot forged but are not subject to additional hardening by heat treatment. The homogeneous deposit exhibits excellent resistance to oxidation up to 1700° F. (928° C.), is very corrosion-resistant to most acids and has excellent gall resistance against materials other than itself. More than 80 per cent. of physical strength is retained at 1000° F. (538° C.), 70 per cent. at 1400° F. (760° C.). At 800° F. (425° C.) 90 per cent. of hardness is retained. Coefficient of expansion is 8.3 x 10^6 in. per °F.

THE INSTITUTE OF VITREOUS ENAMELLERS

Silver Jubilee Conference 1959

Report of Technical Sessions

(*Continued from page* 368, *October* 1959 *issue*)

Abstract No. 4

CONTROL OF FURNACE TEMPERATURES

*by W. J. Swinn**

ALL automatic control systems are based on the fundamental idea of feedback whereby a deviation of output from a predetermined level *e.g.* a change in temperature is measured and compared with the preset value ; a signal corresponding to the difference is transmitted to the controlling means which applies correction to the input through a final control element to restore the output to its set value.

Changes in temperature in an enamelling furnace can result from a combination of factors affecting the balance between heat input and heat loss. These can be listed as follows :

Changes in uncontrolled variables.
Changes in work load.
Changes of input supply.
Changes in control set point.

Uncontrolled variables include, for example, ambient temperature, door opening, and refractory wear.

The accuracy of a temperature control system is largely determined by the magnitude of a number of time lags occurring in the feedback system. These lags can be classified as follows :

Detection lag. The extent of this lag is determined by the accuracy with which it is possible to measure the temperature of the enamelled ware in the furnace. The type of thermocouple used and its positioning can cause variations and some advantage in speed can be obtained by using a radiation pyrometer sighted directly on the work.

Measuring lag. Although the electrical transmission from the thermocouple or pyrometer to the measuring instrument is practically instantaneous the response of the instrument will depend upon the type involved. Extremely rapid response is now possible by using the electronic balance potentiometer.

Control Unit Lag. Control units utilize electric, pneumatic or hydraulic means of forwarding a signal to the actuator and in most cases the signal lag is negligible.

Final control element lag. The lag in operating the regulator of the input to the process varies considerably with the method of operation but should be kept down to a reasonably low figure to avoid excessive cycling.

Modes of Control

Modes of control have been devised to meet load changes, lags and varying plant characteristics and are of differing complexity and cost.

On/Off Control. This is the simplest form of control in which the fuel is shut off after the temperature has reached the set point and brought on again after it consequently drops below. This can result in considerable cycling and consequently difficulty in determining the precise temperature of the work in the furnace.

Floating Control. By establishing a neutral temperature zone, control of reasonably steady processes can be maintained. The degree of temperature cycling, in this case, depends upon the speed of the control unit, the rate of the temperature reaction and the width of the neutral zone.

Proportional Control. A temperature band is pre-selected, such that the fuel input is varied proportionally with the temperature variation above or below the set point. This enables equilibrium conditions to be stabilized for either large or small heat requirement. Again cycling can be eliminated by adjusting the band width to match the speed of the temperature control reactions.

Integral or Reset Control. Since the equilibrium temperature may be lower or higher than the set point but within the band width, a reset control is added to the proportional control form and automatically moves the proportional band in the correct direction about the control setting.

Derivative or Rate Action Control. When large temperature changes occur and the rate of fuel change is too high to be followed by its correction

*Honeywell Brown Ltd.

mechanism, the proportional band is automatically contracted and larger fuel control takes place until the abnormal conditions have passed.

Control Units

Effective control methods may be accomplished electrically, pneumatically or hydraulically, for any type of input regulator. Hydraulic actuation is preferred for reasonably high-speed large power cylinders, where more power and a long stroke are required. Installation of this equipment for the three modes of control is, however, difficult and it can usually only accomplish proportional control with integral action. A range of power cylinders is available with strokes up to 32 in. and bores up to 12 in., which give controlling forces of 11,000 lb. with an air supply of 100 lb. per sq. in.

Many variations of control are obtained with pneumatic actuation and it is particularly advantageous where fire-hazard precautions have to be observed. The most common type of pneumatic power unit is the diaphragm motor which actuates the lever or the control valve. Very sensitive control can be incorporated by using a valve positioner unit, designed to regulate the air pressure with demands from the controller and is particularly recommended for large valve sizes or small stem movements. For extra power the springless diaphragm motor can be used.

The simplest form of control unit is the electrically-operated magnetic valve, limited to an open or shut action but with the advent of electronics all modes can be accomplished. Electric control motors, usually supplied for fuel control purposes, are capable of handling media likely to congeal and can supply 100 lb. torque and operate balanced valves up to 6 in.

Control Valves

The controllers concerned here are all error-correcting which means in the case of two-position control the only variable is the rate at which the actuator moves, provided maximum flow is obtained. However, where proportioning or multi-position control is involved, an attempt must be made to have a definite relationship between the amount of temperature deviation, the movement of the actuator and the resulting corrective action of the input. It is essential in this case for the valve to be correctly sized to pass the maximum flow at the maximum effective opening.

Electric Heating Control

Regulation of electric heating is not so straightforward particularly where large currents are involved. Sequence switching of all or banks of elements or pulsing the on-off periods does, to some extent, give overall proportional control and include integral control, but this necessitates the special design of contacts to withstand frequent operation. Another method of control is where the controller regulates a small direct current to a saturable core reactor which in turn varies the supply voltage. Some amplification is usually necessary since the amount of direct current depends upon the size of the reactor. The three modes of control can be incorporated with this type of control and the need to have non-cyclic forms of heating has resulted in this method being used on large as well as small heating units.

Other Factors Affecting Temperature Control

Combustion Control

Efficient burning of the fuel has a marked affect on temperature control. In all burners using gas and air, it is imperative that the fuel input control is linked in some way to a valve controlling the air inlet so that maximum combustion efficiency is obtained at the maximum and minimum positions. In the smaller burners the correct gas mixture may be obtained by a suitable venturi mixer, the inspirating combustion air being proportional to the gas pressure which is controlled by a zero governor. In the larger burners the relationship is set by means of a linkage adjustment, and the valves must be able to take up any position for maximum efficiency when proportional control is being used. Another method of control used where precision is required, is to allow the temperature to regulate one variable involved and have a ratio controller maintaining the other. Alternatively the temperature control signal may be used to regulate the control set points of the individual flow controllers so that one may vary with the other, thus allowing any ratio setting to be made.

Safety Features

Automatic temperature control makes it necessary to ensure that the system will fail safe in the event of any failure in one of the variables being controlled. Flame failure, a typical example and not always obvious to the operator, can be overcome by using a flame detection device ensuring that the pilot burners are ignited before the main burners are brought on. All services required for the furnace should, therefore, be carefully studied so that a list of safeguards can be reviewed.

Problems Associated with Batch Furnace Temperature Control

A batch furnace is one where a cold or preheated load of material is charged and brought to a pre-set temperature and kept at that temperature until it is considered to be soaked evenly. It is, however, difficult to use conventional equipment, due to interference with the charging devices Instead, a thermocouple is inserted into the furnace space. The rapid drop in temperature encountered when the furnace is charged with fresh material,

causes full heat to be supplied. As the material temperature approaches that of the furnace, the heat input is reduced until it balances the furnace losses, which may be as little as 5 to 10 per cent. Often the initial furnace setting is higher than the process requirement, in order to speed batch heating.

Programme Control

In many cases of heat treatment, temperature control is accomplished by cutting a suitable cam to follow the heating programme, and fitting it to the control instruments. This is a useful arrangement when the furnace is divided into several zones, as one master time pattern controller can be used to regulate several control instruments. A controller, fitted with a reversible motor drive can be used should the temperature-time curve be linear. Which ever method is used the programme can be arranged and automatically applied and a signal raised on its completion.

Problems Associated with Continuous Furnace Temperature Control

The effect of material density on temperature heating in furnaces where the load is continually changing presents another control problem. The temperature control cannot be entirely automatic but depends upon manual selective weight loading, conveyor speed setting, and the furnace temperature setting. Where the weight load is not subject to sudden fluctuations, the conveyor speed and furnace temperature functions can be separated, the main difficulty being to measure the temperature of the moving material. This can be accomplished by the use of a radiation pyrometer which with the additional aid of a photo-electric cell can restrict control action to the demands of the material temperature.

Flexible control units fitted to a multi-zoned furnace and a certain amount of trial and error can result in a series of control combinations. The use of the best equipment available is always a good policy and planned installation will result in low shut-down times and easy maintainance.

DISCUSSION

THE CHAIRMAN (Mr. A. Biddulph) drew attention to a reference by Mr. Swinn to control systems on furnaces in which the pyrometer was sighted on the ware, and asked if he would recommend to the enamelling industry a system of that type as a means of control rather than the use of a pyrometer in the furnace itself.

MR. SWINN said that this question was a recurring one in many industries, and the answer depended on the type of furnace and the type of ware. Radiation pyrometers were not so definite for measuring temperature as were thermocouples ; there were other features which affected the problem, and there were changes in the emissivity of the material. When a radiation pyrometer was installed there had to be a certain period of investigation to determine what the emissivity of the material to be sighted really was, so that the temperature reading on that instrument would not be upset. In most cases there was a combination of two controls — furnace temperature control by a thermocouple (which was limited to a maximum temperature) and work temperature control to give the finer control of the work. When a radiation pyrometer was used on a material there came a stage at which investigation was needed and it was necessary to seek the co-operation of the instrument makers. The user's co-operation was also required.

MR. S. E. A. RYDER (Member of Council) said that mention had been made of an underfeed stoker as a further means of controlling atmosphere, and he would be grateful if the author could elaborate a little on that matter.

MR. SWINN said the idea in having the furnace atmosphere control was to maintain a constant pressure in the combustion chamber, and to maintain it simply. The user must be able to change the setting and achieve the maximum combustion. His point was that, if the pressure were too high in the combustion chamber or the flue, the products of combustion started to percolate through the walls if they were not absolutely tight. On many furnaces there were high and low controls ; the damper was moved in conjunction with the fuel valve and the positions were set at one time. The weakness was that the conditions did not always remain the same, and that required an adjustment to the linkage.

In the muffle furnace presumably there would not be any products of combustion, and the atmosphere was that which the user put into it, *e.g.*, a non-oxidizing or inert gas, which was the normal practice in steel annealing where a bright finish was required. If the process were continuous, the material was run through a muffle which was sealed and filled with hydrogen, or perhaps ammonia; in the case of a batch furnace an inert gas was fed in under the cover.

There were instruments available to analyze for oxygen and hydrogen and CO_2 ; in a muffle that was a separate control feature. If the furnace were not a muffle it was necessary to feed in the fuel, whether gaseous or oil, to get proper combustion either with excess of oxygen or with reducing atmosphere. An instrument which detected free oxygen in the waste gas could be used and the ratio between the fuel and combustion air biased to maintain a pre-set oxygen content.

MR. RYDER said he believed that most modern furnaces had linked damper control. But, as Mr. Swinn had mentioned, conditions varied — wind conditions, atmospheric conditions, etc. — and

adequate attention was needed to keep a furnace working at its maximum efficiency. He wondered whether the pressure control on the combustion chamber might not be a better means of ensuring that the fuel was used efficiently, probably with excess air down to the minimum, and at the same time having a negative or at least not a positive, pressure, in the combustion air to prevent infiltration into the nozzle.

MR. SWINN replied that the selection of the point at which to measure draught or pressure varied but the damper was required to maintain efficiency under all conditions.

MR. R. M. WATTERS, referring to the setting control, asked if Mr. Swinn would recommend a pyrometer with a cut-out valve further down the line.

MR. SWINN replied that a cut-out did not need to be a precision instrument to give the precise temperature, but had merely to operate at some particular point. If a shut-off valve were added, its cost would depend on the line size, and it was necessary to decide whether to spend the money on "insurance" against trouble arising in the future.

Instruments today were not 100 per cent. perfect, and sooner or later would fail to function correctly. It depended on the degree of maintenance given to the instrument equipment and it was the supplier's responsibility to settle the matter with the customer, to assess the prevailing conditions and decide whether or not to advise the fitting of an additional instrument.

MR. WATTERS said Mr. Swinn had mentioned a valve failing to close, and he felt that perhaps there should be a further cut-out instrument provided.

MR. SWINN agreed that this was quite a good proposition. But an instrument could incorporate a further setting so that if, for example, the temperature continued to rise, a warning would be given.

MR. BLACKBURN said that if a continuous furnace became over-loaded, as it might do due to various causes, it was possible that the work would come out under-fired, with a loss of colour, and so on.

He referred to Fig. 11 in the paper and asked whether the conveyor speed regulator was controlled from the pyrometer.

MR. SWINN said the instrumentation provided that, if the temperature decreased, the conveyor slowed up. He could not say whether or not such a furnace was used in connexion with vitreous enamelling, but there was such a system on metallurgical furnaces. He could appreciate also that such a system would be useful in plant for the heat treatment of ball bearings.

MR. BLACKBURN asked if it should be applied to vitreous enamelling; it would prevent under-firing, for example.

MR. SWINN said he thought so, with the proviso he had made earlier, that radiation pyrometers did not give an exact reading under all conditions. The matter had to be studied; his company would hesitate to put forward such a scheme unless they thought the customer could operate it to advantage. However, he felt it was a proposition. At the same time, considerations might be given to achieving the same purpose in another way. A furnace should not be at maximum firing all the time under automatic control; if it operated at the maximum for a preset time, which might be 80 or 90 per cent. of the full time, a warning could be given at that preset time to indicate that it had been working "flat out" and that it was time to cut down a little.

Nevertheless, he did think that the radiation pyrometer could help in vitreous enamelling, with co-operation between the suppliers and the users. He believed radiation pyrometers were being used to control frit furnaces, and that they were very satisfactory. He had not seen one in vitreous-enamelling furnaces, but on metallurgical furnaces they were working admirably.

MR. FINON said he presumed that all pyrometers were heated up mostly by radiation, unless there were strong convection currents. In electric furnaces the pyrometers were close to the elements and tended to measure the element temperature rather than the load temperature. He asked if radiation pyrometers were affected by the original colour of the articles being heated.

Electric Furnaces

MR. SWINN commented that perhaps he had not referred in the paper to electric furnaces to the extent that he should have done. But he had referred to a thermocouple which did need some attention in any kind of furnace because it had to read a compromise temperature.

The radiation pyrometer he had referred to was not colour sensitive, but it was sensitive to change of emissivity.

A precaution which had to be taken in an electric furnace was to put in a shield, so that heat from the elements did not reach another surface, from which it was reflected to the pyrometer. When reading a surface it would not be unduly affected by the change caused by switching elements on and off in automatic control. The radiation pyrometer read what it saw and it read reflected and direct heat. That was why more care had to be taken in the initial installation.

MR. BAINES commented that with a continuous furnace the furnace temperature could be tied to conveyor speed. Also a photo-electric cell could be provided to de-energize the controller if there were no moving "target."

MR. BRADBURY said that in an installation which

would be operating very shortly a feature was that the sighting of the radiation pyrometer was actually done on the hooks which carried the load through the furnace. This system could be used to regulate conveyor speed on a continuous furnace unit and as the cross-sectional area of the hooks remained constant the temperature also remained constant.

MR. SWINN said that the disadvantage with this method was that the ware might not be at the same temperature as the hooks on which it was hanging.

MR. BRADBURY said it was not suggested that the hook was actually at the temperature of the ware, but there was a constant difference of temperature between the hook and the ware. If the temperature of the ware dropped, the temperature of the hook would drop, and *vice versa*. In the ware going through the furnace there were different types of surfaces with different refractoriness, whereas the surface of the hook remained the same. It was not yet known positively how accurate the control would be, but continuous strip furnaces and the like used the method.

Abstract No. 5

THE CORRECT USE OF OIL FUEL AND OIL BURNERS

*by G. O. Fenner**

Choice of Fuel

THE use of fuel oil in industrial furnaces has grown steadily since its introduction after the first world war. Being a refined fuel, it is unlikely to be the cheapest in terms of cost per therm, and it is therefore important to consider each furnace individually before deciding upon the technique and fuel to be used.

The most important characteristic of oil fuel is the ease with which it can be burned to produce a high-temperature flame with a high emissivity, since most metallurgical furnaces work at comparatively high temperatures. Ease of high density storage, handling and control are other attractive features of this means of heat input to furnaces and full advantage should always be made of them.

There are four major grades of oil fuel, each having slightly different characteristics. The lighter fuel oils commend themselves for small furnaces, particularly where accurate control of furnace atmosphere is required. The heavier grades, having the advantage of higher emissivity, are more suited to the larger, high-temperature furnaces. Consumption rates are greater with the heavier grades but generally the fuel oils become cheaper as the specific gravity and viscosity increase.

Storage Capacity

The significant characteristics which affect the storage and handling of fuel oils are viscosity, flash point, specific gravity and pour point and since it does not deteriorate, large emergency stocks can be easily stored.

Viscosity. The design of pipelines and heat exchangers depends largely on the flow rates and pressure drops incurred and therefore the rapid decrease of viscosity, and hence the increase in fluidity of fuel oil, is very important.

Flash point. All the commercial grades of fuel have flash points (not to be confused with the spontaneous ignition temperature) higher than 150° F. It is not, therefore, subject to the Petroleum (Consolidation) Act, 1928.

Specific Gravity. Fuels oils are sold on the basis of volumes and specific gravity is important when volume corrections are made. The calorific value of the fuel is also proportional to its specific gravity.

Storage and Handling Temperatures. It is necessary to heat the oil in storage to ensure its fluidity through a supply system. The extent to which it is heated depends upon the type of burner used and a recommended list of temperatures is available. Storage-tank temperatures can be maintained by immersion heaters, steam or hot-water coils, and must be capable of heating the maximum likely draw-off quantity. The suction line between the storage tank and the pump should be traced with steam or hot-water pipes or in the case of heavy oils with electric pipe-heating, to prevent the line going cold during shut-down periods.

Oil Ring Mains

Many oil-burning installations circulate the oil, prior to burning in the furnace, in either hot or cold oil ring mains, where it is heated to the atomizing temperature. Hot oil circulation allows the use of smaller-diameter ring mains and requires only two line heaters (one standby). The type of ring main used, will be influenced mainly by the economic factors involved, but it has been found that the hot ring main is most suitable for fuel distribution to a number of furnaces. An accurate control of the rate of flow is also necessary and since the flow is a function of viscosity, the number of temperature variations should be minimized. This can be accomplished by looping the ring main as near as possible to the burner, in the case of hot oil circulation, and by placing the line heaters near the burners, when cold circulation is employed. Branch lines should be short, and of the correct diameter, being a potential source of much trouble.

Constant pressure is maintained by circulating two or three times the quantity of oil required for normal consumption and by having a large diameter ring main to minimise friction losses. An approximation for the loss of head due to friction is given by :—

*Divisional Fuel Oil Supervisor, Shell-Mex and B.P. Ltd.

$$E = \frac{0.0765 \times T \times V \times L}{D^4}$$

where E = loss of head in ft.
T = quantity pumped in ton per hr.
V = viscosity Redwood No. 1 at mean pumping temperature.
L = length of pipe line in 100 ft.
D = nominal bore of pipeline in inches.

This formula holds good for streamlined flow, which is defined as :—

$$\frac{T}{D \times V} \text{ not greater than } \frac{1}{30}$$

A pressure-regulating valve, suitably positioned, is sometimes used to control the ring-main pressure, and when this is required to be less than the storage tank pressure, a vented float-controlled constant-level tank is incorporated. Wherever possible, ring mains should be self-draining and be fitted with vents and drains on all branch lines and loops.

Filtration is another important aspect of correct fuel handling. This should be carried out in two stages ; first, to protect the pumps, a coarse-gauge mesh should be used, and, second, a finer-meshed filter should be included to protect the metering orifice in the burner valve. The size of the mesh required varies, but 20 mesh is adequate for the first filter and from 80 to 200 for the second, depending on the type of burner used.

Choice of Oil-burning Equipment

Most oil burners are basically atomizers and usually incorporate some method of using the combustion air as the energy source for atomization. The size and shape of the flame produced depends largely on the degree of atomization and the rate of oil/air mixing, which gives rise to three main types of burner.

(a) Low-pressure air, passing from 15 to 100 per cent of combustion air at 12 to 35 inches w.g. pressure through the body of the burner.
(b) Medium-pressure air, passing from 3 to 10 per cent of combustion air at 3 to 15 lb. per sq. in. through the burner, the remainder through a forced air casing around the burner.
(c) High-pressure air, passing from 2 to 10 per cent combustion air through the burner at 25 lb. per sq. in. and above. Steam is often used instead of air.

The choice of burner is arbitrary, but those relying upon induced air supply cannot be used if the furnace is working with anything more than a very marginal internal pressure.

A number of proportioning devices are available to control the quantity of combustion air used. The most widely accepted is the self-proportioning type which adjusts the oil and air supply by converging nose cones and is particularly successful, effecting fuel saving, when fitted to hand-controlled furnaces.

The number of burners fitted should be determined as follows :—

(1) Maximum and minimum thermal requirements of the furnaces.
(2) Physical dimensions of the furnace.
(3) The type and uniformity of heat transfer required within the furnace.

However, it is advisable to seek expert advice before selecting equipment.

High Intensity Combustors. The purpose of these units is to provide hot gases from fuel burned completely within a comparatively small combustion chamber. Modern combustors are available which require less than one-sixtieth of a cubic foot for each gallon per hour of fuel and recirculate the hot gases to the root of the flame, the turbulence causing very rapid mixing of air and fuel. The hot gases leave the combustor at up to 1000 ft. per second, causing rapid recirculation which in turn helps to produce more uniform rates of heat to the stock.

Setting up Oil-burning Equipment

Before attempting to light-up newly installed oil-burning equipment. the oil and air services should all be tested, fuel oil circulated through the pipes to trap loose particles of matter in the filters, and temperature and pressures checked against the manufacturers' recommendations. The atomizing air line should be blown clear and pressure-tested with air only. Only when these tests have been carried out should any attempt be made to light the burner.

Incorrect fuel/air ratios can seriously impair the efficiency of a burner ; too little air results in much of the heat in the fuel escaping with the flue gases and too much air can seriously reduce the flame temperatures. Graphs are published relating these parameters with the maximum theoretical flame temperature, and are worthy of detailed study as the relationships at high operating temperatures are quite startling.

Oil-burner Maintenance

It is essential that all variables should be known and controlled, and suitable gauges fitted for this purpose, indicating the following

(a) oil pressure
(b) oil temperature
(c) atomizing air pressure
(d) secondary air pressure

The oil burner is a precision instrument and can only be expected to function efficiently if maintained correctly. Coarse cloths and hard metal tools should never be allowed to scratch the parts, the

wisest policy being to install a spare and clean the burner at leisure. Many serious problems can be avoided if attention is given to the fundamentals and the equipment is adequately maintained.

DISCUSSION

THE CHAIRMAN (Mr. J. Nicholls) said that it had been stated that some of the controls referred to in the paper were not necessary. But at his works they were now in process of putting in a new furnace and he would see that the controls were put on to it. Then he would be able to appreciate the difference between the new and the old installation.

MR. NEWMAN said that high-intensity burners were already being used in refractory-lined combustion chambers of very small dimensions, injecting the hot gases and recirculating them in radiant tubes. Gas-fired furnaces of this type for vitreous enamelling had been built, and an oil-fired furnace of the same type could be made.

He mentioned a case where an oxidizing atmosphere was necessary and the presence of sulphur or any reducing gases was of critical importance ; on this installation the burners were obviously of scientific design, in radiant tubes, and there was no reason whatever why they should not be used in the enamelling industry.

MR. PATRICK said that he was frequently offered sludge-dispersing media for use in fuel oil. He asked why such materials were not already incorporated in the oil by the oil companies if they were in fact able to do all that was claimed for them.

MR. FENNER replied that his two parent companies had done an immense amount of work on this matter, but had not yet been able to find any proprietary sludge disperser which would work under all circumstances. The difficulty was, unfortunately, that whereas the physical characteristics of a fuel oil remained the same, its chemical characteristics varied. There were the asphaltic and paraffinic groups, and those two types could be sub-divided many times.

But it was true that some additives which were claimed to disperse sludge would function if the sludge was of a certain type. It was quite possible for a sludge disperser to work effectively for a time, and then to fail, although the oil was of exactly the same specification and obtained from the same supplier. He knew of many cases where the sludge problem had been overcome and of many others where it had not.

MR. C. P. STOKES referred to de-sulphurizing agents which were available to add to the oil, and asked if Mr. Fenner had had experience of them.

MR. FENNER said there were two distinct problems. He was not certain in what way sulphur worried any particular user of oil, whether the sulphur was present as SO_2, or SO_2 and SO_3, or just SO_3. If in fact it was only SO_3 that caused the worry, there were additives which would minimize the production of SO_3, but they could not possibly have any marked effect on SO_2. However, 95 to 98 per cent of the sulphur in the oil would be burned to SO_2, and it was physically impossible, with the quantities recommended by the suppliers of the additives, to neutralize all the SO_2, but it was possible for them to neutralize the SO_3.

The point was very interesting, for it was allied to combustion control, in that combustion conditions did affect the amount of SO_3 formed, relative to SO_2. If the oil was being burnt in a slow combustion chamber with excess air, more SO_3 would be produced than if it was burnt at more nearly the theoretical fuel/air ratio. If it were only SO_3 that worried the user, he might be able to reduce the amount of it by examining the combustion conditions.

MR. S. E. A. RYDER (Member of Council) said there was no doubt that SO_3 was very much more harmful than SO_2, but SO_2 was not harmless by any means.

He had no experience of fuel oil or of fuel-oil furnaces, and he was appalled to note that fuel oils contained something like 3 to 4 per cent by weight of sulphur.

MR. STOKES said that SO_3 did affect some enamels and he asked if Mr. Fenner could indicate the furnace conditions which could overcome the trouble.

MR. FENNER mentioned the high-intensity combustion furnace, because in such a combustor the fuel could be burnt with very much less excess air than normally. That in itself would reduce the amount of SO_3 produced, which might well be of some consequence in the enamelling industry.

There were other metallurgical processes where at certain periods—in the melting or the refining of copper, for instance—it was essential that there should be a minimum amount of sulphur. Therefore the burners were supplied with two fuels, and the user could close one valve and open another, make a few minor modifications, and change from a high- to a low-sulphur oil. He felt that if that were done on vitreous-enamelling furnaces it would help to solve the problem of sulphur leakage into the muffle.

Sulphur Content of Fuel Oils

MR. N. F. PARKER, having noted that Mr. Fenner had not given prices for fuel oils, referred to the sulphur contents of the four oils for which particulars were given in Table I. The first oil, a light oil, was stated to have a maximum sulphur content of 1 per cent by weight, which was probably right. The second, a light fuel oil having a viscosity of 220 secs. maximum, was stated to have a sulphur content of 3.2 maximum ; he had known

it to be 3½. The sulphur content of the heavy fuel oil was given as 4.0 maximum ; it might be 4½. It was one of the problems in connexion with the use of oil that, though enamellers might demand a virtually sulphur-free oil, they must be prepared to use oil with some sulphur content. It was a difficult technical and commercial problem and he did not suppose it was possible to give an answer to it. But it was one of the weaknesses of fuel oil that it had an irreducible minimum of sulphur ; In some plants the matter was very much more under control than in others, and there was no likelihood, or practically no likelihood, of the products of combustion getting into the muffle. He also asked whether the recirculation of heated oil in a ring main system was likely to increase trouble at the burner.

MR. FENNER said that with regard to the sulphur content of fuel oils sold by his company. The figures for sulphur content given in the paper were maxima ; the actual figures were usually below those maxima, certainly never above.

With regard to the whole problem of the sulphur content of oil, the position was a competitive one relative to other fuels ; it was impossible to generalize.

At the present moment it was not physically impossible to remove the sulphur from crude oil, but it was just commercially impossible. However, an extensive research programme was continuing on behalf of all oil companies, for they had to find a method which did not price them out of the market.

He made the point that coal was still used in the enamelling industry and it was necessary to have a sense of proportion when dealing with sulphur content of a fuel, to relate the percentage of sulphur by weight to calorific value and to efficiency per cent. It did not necessarily follow that a fuel containing 2 to 3 per cent by weight of sulphur was twice as bad as another fuel which had half that sulphur content.

As to the effect of the heat treatment of oil in hot oil ring mains, it was the experience that, provided the hot oil was always returned to the suction side of the pump, and not put into a cylinder on top of the storage tank, the users would not do any damage whatever by recirculating it at 160° F. If hot oil were exposed to the atmosphere above the cold oil storage tank to cool, that could cause the precipitation of waxes as well as asphaltic material.

Use of Gas Oil

MR. STOKES said that he had achieved best results in vitreous enamelling by the use of gas oil ; he believed the actual costs were to the advantage of gas oil.

About the importance of keeping burners clean, he agreed with Mr. Fenner's remarks. At his works the burners were taken out for cleaning every day ; they had reduced the consumption per ton of frit by 10 gallons, and at the same time they were able to increase their production on a 24-hour day.

A SPEAKER said the batch furnace was much more tolerant to the sulphur content of the fuel than was the continuous furnace.

He asked whether Mr. Fenner had received any complaints about the emission of blue fumes from the products of combustion.

MR. FENNER replied that blue fumes from the exhausts of oil-fired plant invariably indicated incomplete combustion.

THE SPEAKER added that, in his case, the draught had been increased, bringing up the excess air to 100 per cent, and the CO_2 content came down to 8 per cent ; it was previously 14 per cent. The residues had been analyzed and samples were taken from the ash of the fuel oil and the decomposition of the refractories was examined. The refractories had deteriorated rather faster than was expected, and it was obviously due to the high sulphur content.

MR. FENNER felt sure that it was not. Having ascertained that the furnace was a continuous one, he said that if the CO_2 from a continuous furnace was determined immediately after the combustion chamber, then 10 ft. along the flue and still another 10 ft. further along, it would be found that there was recuperation in the chimney air, and the CO_2 content was falling all the time probably ; even the 8 per cent CO_2 was probably determined near the exhaust end. It did not mean that the oil had sufficient, or 100 per cent, excess air at the temperature zone within the furnace where that air was in use. The air might enter the flue system at below 700° F. and very little of it would assist in combustion. He suggested that the speaker should take the waste gas samples for analysis as close as possible after the combustion chamber, and not too much towards the exhaust end. Also, the combustion chamber might be working under reducing conditions, and those conditions, rather than the sulphur, were causing the heavy wear on the refractories.

Abstract No. 6

REFRACTORIES

by D. Dixon

THE last 30 to 40 years has been a time of great change and expansion for the refractories industry as for other industries, and a knowledge of the early methods employed helps the appreciation of the progress made during the last century. It has been said that technical advance has outpaced possible commercial applications, but with the many raw materials available the trend is for

refractories to be " tailor made " for specified jobs.

The output in Great Britain is about two million tons yearly, comprising about one million fire-clay, half-million of high alumina, silica and basic, the remainder of ground fireclay, cements, monolithics and sundries. The usual classification is :—

(1) The " acid " group consisting of silica and semi-silica.
(2) The " basic " group consisting of magnesite chrome, dolomite and forsterite.
(3) The alumino-silicate group consisting of fireclay and the high-alumina grades based on kyanite, sillimanite, andalusite, and bauxite.
(4) The sundries group which includes carbon, plumbago, silicon carbide, fused alumina, zircon, pure oxides and cermets.

The silica rock known as quarzite is crushed, mixed with lime and an organic bond, and fired in intermittent or tunnel kilns to 1450 to 1500° C. which converts the quartz into tridimite and cristobalite.

A recent development has been the calcination of flints as a material for high-grade silica brick. Rigid and stable in volume at temperatures close to their fusion point, 1710 to 1725° C., they are used for continuous service under load. They have, however, a high and irregular reversible thermal expansion and are unsuitable for furnaces operated intermittently with frequent temperature changes. The action of flux-laden combustion gases and fuel slags on the heated surface of semi-silica refractories is to form a brick-slag interface which resists erosion at medium temperatures. The mixture of silica and clay, known as ganister, is being used for facing furnace linings, etc.

The maximum service temperature of basic refractories, manufactured from magnesite, of about 2000° C. gives them one distinct advantage over silica, particularly in steel melting. Generally, though, their physical and chemical properties make them less attractive, one weakness in service being the tendency to shelling of the hot face because of changes in temperature and furnace atmosphere. Because of their resistance to alkaline dust, they are being used in certain continuously-operated furnaces and some are being chemically bonded and steel cased to eliminate kilning.

The needs of the enamelling industry are met by the alumino-silicate group with some silicon carbide and fused alumina which are useful because of their high thermal conductivity. Great Britain is fortunate in fireclay deposits for firebrick with fired analysis of 35 to 42 per cent alumina, and Scottish manufacturers find the combination of good deposits, modern plant and convenient ports particularly suitable for foreign trade.

Much information has been provided by the scientist about the structure of clays and they have been classified according to the arrangement of the atoms. Two of the chief groups are kaolinite, which includes china clay, and montmorillonite, which includes bentonite. This research has helped to define the limitations of fireclay refractories and it is now known that there can be no super fireclay to meet many conditions of high-temperature service. Moreover, the fireclays as mined and used, contain troublesome impurities and have a high water content, making cost prohibitive and resulting in high shrinkage in drying and firing. The trend has therefore been towards precalcined aggregates in semi-dry mixings of 5 to 10 per cent water content, machine-pressed or tamped and fired in tunnel kilns to ensure close control of final heat treatment.

Alumina content or high fusion point may not be the most important properties and selection may sometimes be difficult. The properties available in refractories are high or low porosity, resistance to high temperature or sharp temperature changes and strength at high temperatures, some of which are conflicting. There are many fabrication techniques and it is only now being realized to what extent fabrication affects the resultant properties of the refractories.

Three crystalline alumino-silicate grogs, kyanite, sillimanite and andalusite are all converted by high temperature into mullite with an alumina content of about 70 per cent. The fusion point is about 1810° C. and the structure is a mass of interlocking needle shaped crystals ; the Bowen-Greig-Schairer phase diagram shows that mullite is the only alumino-silicate stable at high temperatures of the order of 1600 to 1800° C. Synthetic mullite grogs are produced from mixtures of alumina and silica by high-temperature treatment and electrically-fused grogs are now in use both in the U.S.A. and this country.

The nomenclature of the many grades of high alumina refractories is confusing and needs clarifying. Many sillimanite refractories are based on calcined kyanite which can readily be converted to mullite. Blocks of sillimanite are used for walls of glass melting tanks. For high temperatures calcination is advisable to avoid crystal changes.

The value of the 60 to 75 per cent alumina refractories is in their freedom from after-contraction, their refractoriness under load, their resistance to many slags and their safety from fracture under temperature changes.

The sundries group of refractories is very specialized ; some are already well established while others are still in the development stage. The most important for the enamelling industry are silicon carbide and fused alumina. Both are abrasive grits, produced by fusion in electric furnaces and they are also refractory grogs. Silicon carbide has no fusion point but dissociates at over 2000° C.

The carbon content burns in a strongly oxidizing atmosphere particularly at temperatures of 800 to 1000°C., leaving a disintegrated silica body. It has a high thermal conductivity, and is very stable at high temperatures.

Zircon is a zirconium silicate of 67.25 per cent zirconia and 32.75 per cent silica and is recommended for reverberatory aluminium melting furnaces and for furnaces melting heat-resisting borax glass and opal glass. They are also suggested for furnaces melting high-lead frits and cover-coat frits containing antimony, titanium or zirconium.

One important development in the refractories industry since the war is the use of special-purpose coatings particularly the refractory concretes composed of grog and aluminous cement for installation of monolithic linings. Another development is the porous firebrick of low heat capacity for high-temperature thermal insulations.

Frit Melting

The properties required in the linings are not high refractoriness but resistance to solution and erosion by molten frit at medium temperatures, indicating fireclay brick of around 40 per cent alumina and low iron content. Guidance as to the most suitable brick can be ascertained by the comparative test of heating samples of frit on alternative refractories.

Fusion Furnaces

The later batch-type furnaces, oil- or gas-fired, would have fireclay brick for the outer construction, cased with porous fireclay brick to reduce heat capacity and radiation losses. Silicon carbide or fused alumina panel bricks or slabs secure the thermal conductivity required in the muffle shell, including the floor, and silicon carbide may also be preferred to fused alumina in oil-fired furnaces taking heavy charges because of its higher thermal conductivity and faster heat recovery. For sheet enamelling, a fused-alumina muffle and a mullite combustion chamber seem to be the best selection.

For continuous furnaces, the selection of refractories is on similar considerations with fused-alumina panels or rectangular tubes in the side walls to give heat transfer. In the roofs of continuous conveyor furnaces, the property most required is safety from fracture in suspension.

For electric fusion furnaces, material with good electrical insulation is selected to carry the metallic, or for high temperatures, silicon-carbide heating elements. An external casing of porous insulating brick provides thermal insulation.

Finally, mullite-porcelain sheaths are used for the protection of rare metal couples, recrystallized alumina insulators, free of silica, for the thermocouple wires within the sheath and clay crucibles for melting small quantities of frit.

DISCUSSION

DR. STEBMAIER asked if it were a fact that zircon refractories had very low permeabilities.

MR. DIXON said he had no information that zircon refractories generally were less porous than the alumino-silicate type. It was difficult to obtain experience in this country on the use of zircon. When he was in the United States in 1946 a company making zircon brick and calcined zircon brick had told him that their chief markets for zircon were for aluminium melting, borax glass and the enamelling industry. It had come into use in the glass industry quite generally for heat-resisting-glass furnaces. Borax glass had to be melted at a substantially higher temperature than lime-soda glasses and apparently was not so erosive. He could only quote from a catalogue which recommended zircon refractories for the production of enamel frit. It stated that the bricks were machine pressed and dense and of good shape, which was something that all manufacturers said of their bricks.

MR. MURDOCH asked for Mr. Dixon's comments on the performance of a high-alumina refractory in a furnace burning oil having a sulphur content of the order of 3½ per cent, and how it compared with its performance when the fuel used had a lower sulphur content. The combustion heat on the refractory was round about 1100°C.

MR. DIXON said the trouble with reducing conditions, reducing by the presence of sulphur or carbon, was due chiefly to the effect of the iron oxide in the refractory. The manufacturers of refractories endeavoured to keep down the iron-oxide content, even in refractories incorporating kyanites, sillimanites, etc. He had asked about such a refractory having an iron-oxide content of 1.2 per cent, and he was told that it should be less than 1 per cent.

The effect of reducing conditions was to convert the ferric oxide to ferrous and therefore to reduce the refractoriness. There was another condition, which concerned the blast-furnace operator, that iron oxide had a catalytic effect on the carbon in the fuel, which might be oil, coke, gas or coal; carbon was deposited in the pores of the refractories and had a disintegrating effect. The reducing condition reduced the iron oxide, which must be present to some extent in the refractory, from ferric to ferrous, and there was the disintegration of the very fine carbon by the catalytic effect of iron oxide spots.

MR. G. O. FENNER, commenting that he had gained his experience in the United States, said that as long as reducing conditions could be avoided it would not be possible to differentiate on the effect of sulphur on the refractories. But in order to achieve reducing conditions where sulphur

(*Continued in page* 66)

A Quarterly Survey of some of the Features in Finishing Literature from Abroad

by **SCRUTATOR**

THE American aluminium industry expects 1960 to be a record year with the two largest outlets being in the motor car and building industries.[1] This should mean increased usage of anodizing, vitreous enamel and chemical conversion coatings. Aluminium has for some time now been on the threshold of the container industry and if it could enter this, a vast new market would be opened up. Aluminium beer cans have been used for some time on the Continent but information has now come from America that Aluminium International Inc., a Company owned by two breweries, has installed a new high-speed impact-extrusion machine which can turn out 120 11-oz. aluminium beer cans per minute.[2] Perhaps 1960 will see aluminium make real headway in the container field.

Although things look very rosy for aluminium, this is certainly not the case as far as magnesium is concerned. Magnesium was pioneered in the United States by the Dow Chemical Company, who have recently announced[3] that they have branched out into the rolling of zinc and aluminium. This is because their time-table for magnesium has lagged behind their hopes and expectations. Presumably this diversification is to keep their facilities operating while magnesium fulfils its sale goal.

Non-Electrolytic Coatings

In his annual review of technical developments for 1959, Nathaneal Hall[4] makes the following pertinent remarks covering conversion treatments:

> "True to form, proponents of conversion coatings continue to produce developments in this phase of finishing at a goodly pace . . . chromate coatings appear to interest as many authorities as do phosphate films."

This was backed up by a list of some 22 patent and literature references. Chromate conversion coatings really came into prominence during World War 2 and there is little doubt that during 1959 there appeared to be a much increased interest in them. Lester F. Spencer[5] has written a very comprehensive review of these films and has given no less than 27 bath formulae for treating zinc and cadmium; copper and brass; aluminium and its alloys; magnesium and magnesium alloys and silver. In addition to their bare corrosion protection, particularly on zinc, and their use for paint bonding on aluminium, he stresses that one of their most widely exploited properties is their low electrolytical resistance, as a result of which they have been widely accepted in the electronic field. In spite of the comments above on the review of magnesium, P. F. George[6] of the Dow Chemical Company has described some recent developments in protective finishes for magnesium. These include the Dow 17 process; a ferric nitrate bright pickle; electroless nickel and a new organo-tin compound. When the latter is used in a paint primer to replace the normal zinc chromate, it is claimed that it will inhibit the galvanic corrosion of magnesium when coupled to other dissimilar metals.

This application for electroless nickel is interesting and for those more concerned in the theoretical than the practical side of this non-electrolytic process, Gutzeit[7] has published an outline of the chemistry involved in the process of catalytic nickel deposition from aqueous solutions. Reverting to the essentially practical aspects, Spraul[8] has given corrosion data for chemical nickel plating when immersed in 100 miscellaneous chemicals and solutions. This is the kind of information which one finds in corrosion handbooks and which proves valuable when trying to assess possible applications for this still comparatively new process.

Plating

The quantity production plating of small components which are too fragile, or contain parts which are too fragile to be barrel plated, has always presented a most difficult production problem. Marotta[9] has described a very interesting technique developed at the Merrimack Valley Works of the Western Electric Co. to overcome this. When the manufacture of deposited carbon resistors was commenced, difficulties were encountered which were directly attributable to the poor quality of the copper/tin electroplate formed on ferrules and lead assemblies. It was clearly much too expensive to jig individually some ½ million components per day but on the other hand, the use of tumbling barrels produced many problems, particularly with the leads. In consequence, they developed a new flat-type electroplate basket which could be adapted to the fully automatic plating machine. First experiments were carried out with

(*Continued in page 66*)

Institute of Vitreous Enamellers

Silver Jubilee Conference

(*Continued from page* 64)

would be a reducing agent with oil fuel there must also be present very large quantities of unburned carbon and also carbon monoxide. The effect of carbon monoxide and carbon particles on the refractories was fairly well established. Sulphur did not enter into it very much unless there were reducing conditions.

MR. DIXON, supporting Mr. Fenner's remarks, said he had experienced a lot of trouble with furnaces due to reducing conditions and bad combustion, but he could not recollect any trouble with refractories due to the presence of sulphur.

MR. N. F. PARKER said that while the refractory materials available were so very diverse and varied in their compositions and in respect of what they could do, so also, unfortunately, the working conditions in the enamelling industry were just as complex. It was possible to obtain a refractory lining which for over 95 per cent of cases possibly would give the results required, but in the remaining few cases it would fail due to some local condition which it was exceedingly difficult to find. Troubles arose due to incomplete combustion and a number of other causes, and these were factors which did not constitute reflection on the manufacturer necessarily, but they provided a reminder that his job was extremely difficult.

MR. ROBERTS, enlarging on the point that both the maker and the user of the refractory had important roles to play, recalled that Mr. Dixon had mentioned a silica from Austria which of itself was first class, but perhaps not sufficient consideration was given to the jointing material that was used with it. This factor of developing co-operation between maker and user was naturally a slow process. The manufacturers now had laid down a tunnel kiln and had studied a number of problems that had arisen, and by improving chimney stacks and so on they were able to create the right conditions ; that was a great thing. However, the user had a responsibility which was at least as great as that of the manufacturer.

MR. DIXON, in thanking Mr. Parker and Mr. Roberts for their remarks, said he realized that there was much more to be done yet in respect of process control by the refractories industry. For many years refractories had been fired in intermittent furnaces where there might be quite a range of temperatures from top to bottom, for example. Tunnel kilns giving much more accurate control of the heat treatment were coming into use, and that would help until there was more knowledge of the raw materials and more realization of the effects of manufacturing processes on the final products. But he thought the refractories industry was moving quite rapidly towards closer process control, which was what Mr. Parker was suggesting as necessary.

Of course, the manufacturer of refractories had always to bear in mind how much he could afford to spend, because the customers had to pay eventually the cost of effecting improvements ; the manufacturer had to consider what he could get for his product, and that was quite a problem. Apart from that, Mr. Dixon believed that the market for refractories was becoming more difficult and those manufacturers who were going to survive had to tackle the question of process control right along the line more closely than they had done yet.

Overseas Review

(*Continued from page* 65)

a brass framework covered with a bronze wire-mesh screen. This screen was later replaced by a non-conducting covering to obviate shielding of the parts during plating.

The final design consisted of a framework of 300 series stainless-steel wire which was PVC plasticol coated all over except for two longitudinal conductors and the outer framework which assisted in equalizing current distribution by acting as a peripheral shield or thief. The basket covering was a woven fabric of high-temperature polythene. It was found that agitation of the parts was not necessary and by loading 800 parts per basket and 4 baskets per rack with a plating machine output of one rack every 2 minutes, their daily production of more than 600,000 pieces per 8 hour shift was easily accomplished.

" The need for a satisfactory accelerated test for evaluating the corrosion characteristics of plated parts has long been recognized by those responsible for plating quality. It is now believed that this need has been met by the copper accelerated acetic acid salt spray Cass Test." It will certainly be interesting to see whether the very high claims made by Sukes[10] of the Cadillac Motor Car Division of General Motors are substantiated when people in this country start evaluating this salt spray test. In essentials, this consists of spraying under carefully controlled conditions a salt solution consisting of 5 gallons of distilled water, 5 per cent w/v sodium chloride, 5 gm. of cupric chloride, with the *p*H adjusted to *p*H 3.2 using glacial acetic acid.

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(9) *Plating*, 1959, **46**, (12), 1359-1363.
(10) *Metal Finishing*, 1959, **57**, (12), 59-65.

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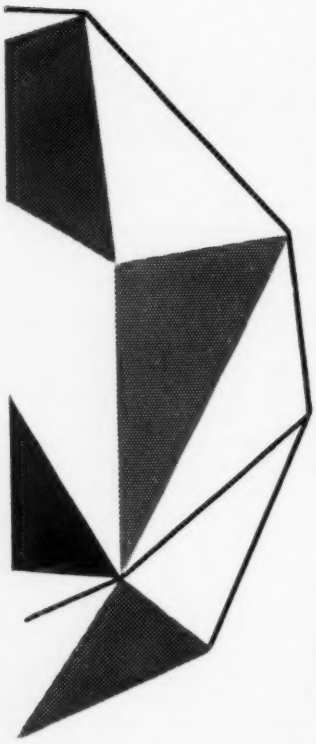

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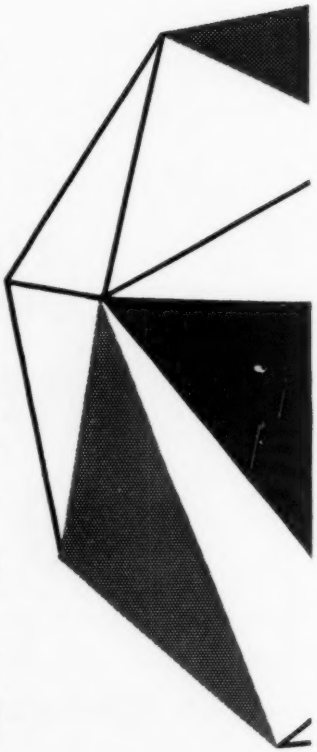

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FINISHING

NEWS REVIEW

150TH ANNIVERSARY OF CANNED FOODS

British Celebrations Inaugurated by Minister of Agriculture, Food and Fisheries

THE first food canning patent, No. 3372, was issued in 1810 to an Englishman, Peter Durand, who lived at Hoxton Square, in Shoreditch, London. Subsequently Durand sold his patent to Bryan Donkin who had a factory in Bermondsey, London, at which the first production of foods in sealed cans commenced.

The British Admiralty became one of Donkin's best customers and in a few years the value of canned provisions had been abundantly proved by many ships' companies, foremost among these being Captain Sir Edward Parry, who made four voyages in search of the North-west passage to India *via* the Arctic.

One of Donkin's cans of roast veal taken by Sir Edward Parry on his voyage of 1824

To celebrate the first 150 years of canning, activities throughout the British Isles are planned, details of which were given recently at a special exhibition in London which was opened by the Minister of Agriculture, Food and Fisheries, The Rt. Hon. John Hare. All the planned activities will emphasize the progress of the industry from the earliest equipment to the most modern techniques of mechanization and automation, both in the canning process and in the manufacture of cans. Organizations taking part include the British Food Manufacturing Industries Research Association, the British Tin Box Manufacturers' Federation, The Food Manufacturers' Federation, the Fruit and Vegetable Canners' Association of Great Britain, The Fruit and Vegetable Canning and Quick Freezing Research Association, the Tin Research Institute, the Tinplate Conference (1925) and the Worshipful Company of Tinplate Workers *alias* Wire Workers.

Similar exhibits to those shown in London will form the nucleus of central and touring exhibitions, designed to bring home the significance of this milestone in food processing and packaging to all parts of the country. For example, historic and modern cans will be displayed at the Ideal Home Exhibition in London from March 1-26. One of the more spectacular exhibits will include cans which survived unharmed the Montebello atomic tests.

Canned Foods Week opens on March 28 in Scotland, a special feature of which will be a public conference organized by the British Food Manufacturing Industries Research Association, embracing the whole field of food manufacture with special emphasis on canning and manufacturing developments.

In late Spring London will offer a further exhibition at the Science Museum which will be linked with a series of specialized talks in the lecture hall. The Food Group of the Society of Chemical Industry are participating in the celebrations with a special symposium on the historical, technical and nutritional aspects of canned foods. The symposium will be held in London in July and will be open to the general public.

Further central exhibitions and displays in London are planned for the Tea Centre, the Food Fair and the Canned Foods Advisory Bureau in Baker Street.

Special celebrations are in preparation for Lowestoft and other major towns in the Eastern Counties, and similar celebrations will be held in various other parts of the country associated with the canning industry.

The Anniversary Year reaches its climax with a banquet in the presence of the Lord Mayor in London's Guildhall in October. Among other events in the meantime, it is hoped to mark permanently a site in Southwark Park Road, London, where Bryan Donkin, F.R.S., put into

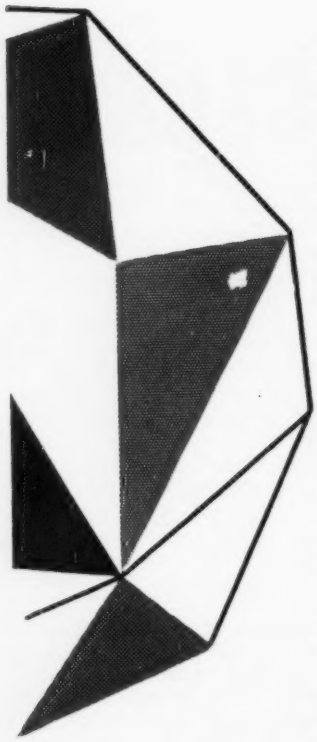
(*Continued in page* 70)

Advantages of

POTASSIUM STANNATE

in

electro plating and immersion plating



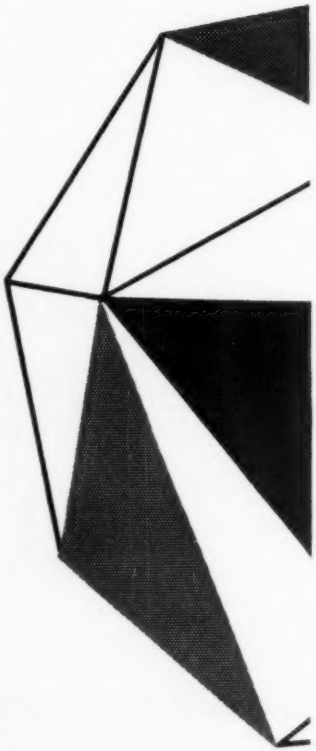
The economic advantages of using potassium stannate are very considerable.

Probably the best known application in immersion plating is the tinning of aluminium pistons. By using potassium stannate instead of sodium stannate it is possible to achieve substantial reduction of sludge formation.

Solutions containing potassium stannate have a far greater electrical conductivity than similar solutions containing the same concentration of sodium stannate. This fact, and the greater solubility of potassium stannate, mean that higher current densities are obtained for a given voltage. Conditions are ideal for barrel plating. Alternatively a dilute potassium stannate solution can give the same plating rate as a more concentrated one containing sodium stannate, so that wastage by drag-out, and initial costs, are reduced considerably.

With High-Speed tin anodes faster plating rates can be obtained. Fewer anodes are required and 'filming' is much easier.

Albright & Wilson (Mfg) Ltd. also supply Phosbrite chemical polishing solutions for copper and aluminium and their alloys, Plusbrite addition agents for bright nickel plating, together with chemicals for special processes in copper and nickel plating and electrolytic polishing of ferrous metals.



For full information write to:

Metal Finishing Department
ALBRIGHT & WILSON (MFG) LTD
1 Knightsbridge Green, London SW1
Telephone: KENsington 3422

TSW/568

FINISHING

NEWS REVIEW

150TH ANNIVERSARY OF CANNED FOODS

British Celebrations

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(*Continued in page* 70)

AUTOMATIC PLATING PLANT FOR IRONMONGERY IN OPERATION

SUCCESSFUL commissioning of a new automatic plating plant at their Haydock (Lancs) factory, is announced by Thomas Crompton and Sons Ltd., one of Britain's leading manufacturers of ironmongery for the aircraft, building, marine, automobile, railway and other industries.

The new automatic plant, which in an eight-hour shift plates up to 30,000 parts with nickel or chromium, replaces a hand-operated system.

Nickel and chromium plating will henceforward be carried out in the new plant, shown in the illustration below, while brass plating will continue on a similar smaller plant equipped in 1957 when the factory was opened.

Both the new and the earlier plating plant have been supplied and installed by the Electro-Chemical Engineering Co. Ltd. of Woking, Surrey.

Apart from saving in labour, the advantages of automatic working, which are confirmed by Crompton's engineers include, regularity of output, simpler quality control, more reliable pre-cleaning and reduced losses of chemicals owing to drag-out spilling.

Installation of this plant is a further stage in automating ironmongery manufacture, which has been carried out in Lancashire by Thomas Crompton and Sons Ltd. for nearly two centuries. Their main market is, of course, Britain, but there is an appreciable export business notably in Canada, New Zealand, South Africa and the West Indies.

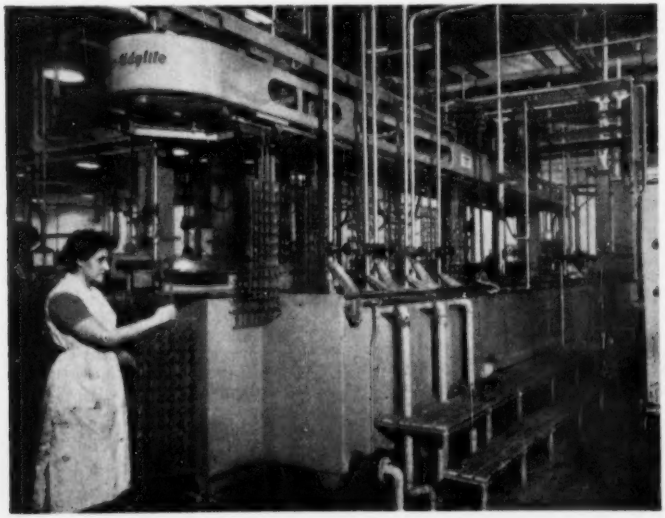
The New Plant

The new electroplating plant is manually loaded at present, but provision is made for automatic loading in the near future. Parts are located on spring racks measuring approximately 30 in. by 12 in. The machine is constructed in three main sections, carried on rolled steel supports, which provide an air space below. Heating is effected by coils and a heat exchanger using steam at 40 lb. per sq. in.

Main processes are cleaning, pretreatment, bright nickel and chromium. Approx. 0.0005 in. bright nickel is deposited in 11½ min. at 60 amp. per sq. ft. or a similar coating of chromium in 5½ min. at 120 amp. per sq. ft.

Transfer of plating racks is carried out by hydraulic cylinders fed by a separate floor-mounted oilpump and pressure assembly which is motor driven; a hydraulic drive control panel is embodied. Rectifiers and transformers are alongside, together with a final drying station.

Overall length of the complete installation is some 37 ft. and the width 13 ft.



Pollucite Deposit Developed in S. Rhodesia

AN extensive deposit of pollucite ore has been developed at Bikita, Southern Rhodesia, according to an announcement by Borax and Chemicals Ltd., selling agents in the United Kingdom, Sterling area and Europe for Bikita Minerals (Private) Ltd.

Tests indicate that the deposit is one of the largest in the world and that it offers a reliable supply of low cost ore. Pollucite, an aluminium-caesium silicate, is a source of caesium for applications in the glass and ceramic industries, in welding-rod fluxes and other uses where silica and caesium can be employed together. The pollucite in the Bikita deposit has an average content of 24.4 per cent caesium oxide.

In the past caesium was available only in small quantities until American Potash and Chemical Corporation, parent company of Borax and Chemicals Ltd., commenced production of caesium metal and compounds at San Antonio, Texas, utilizing Bikita ore.

Bikita's pollucite reserves are part of its large lithium-beryllium deposit located near Fort Victoria, Southern Rhodesia. Bikita Minerals is owned principally by Selection Trust Ltd. (which act as technical managers of the company), American Potash and Chemical Corporation, and American Metals Climax, Inc.

A dramatic potential use for caesium is in ion-propulsion engines for space travel. This type of engine, which is now under development, produce small thrust but becomes practical in outer space after a vehicle's initial speed has been provided by rockets or other powers source. The ion-propulsion engine will then operate over vast inter-planetary range.

Canned Foods Anniversary

(*Continued from page* 69)

production the world's first canned food factory, under Durand's original patent. The organizers of the celebrations also hope to arrange for the participation of Peter Durand's descendants in the Year's activities. A nation-wide search, retracing the last 150 years, is now under way to find the surviving Durands, and newspapers throughout the country have been brought into the hunt.

These activities form a fitting tribute to those industries that have developed the modern can from a happy "marriage" of steel and tin, and have used it for the benefit of mankind.

British—Dutch Metal Finishing Merger

ROTO-FINISH Ltd. of Mark Road, Hemel Hempstead, Herts, specialists in all types of finishing processes for the metal and plastic industries, have acquired a substantial interest in N. V. Roto-Finish Mattschappij, Rotterdamseweg 370a, Delft, Holland, a Company which is engaged in similar business in the Benelux countries.

An agreement has also been reached whereby the sales programmes and the service organizations of the two companies will be integrated. It is believed that by taking this step the markets for both companies will be increased, and that their customers will benefit in that the special experience gained over a considerable number of years by the two companies individually will now become available to customers throughout the combined sales areas, which include the United Kingdom, the Benelux countries and many other countries.

The British Roto-Finish Company is well-known in this country, and to a lesser extent overseas, as the largest suppliers of barrelling equipment and processes to British industry. It is a company which commenced business 12 years ago in a small way but has rapidly expanded so that its interests now include, besides barrelling, the major parts of the finishing processes now in use in the metal and plastic industries, such as electropolishing, plant and processes for cleaning, phosphate coating, etc.

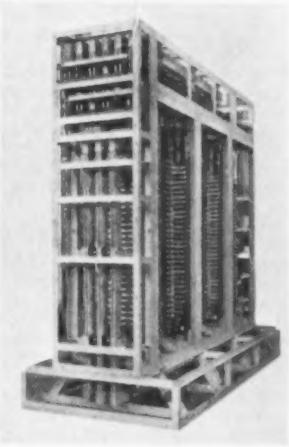
Success Story for Automatic Filter

THE Autoroll, an automatic air filter, was introduced by Vokes Ltd., to the British market approx. eighteen months ago. To date, orders have been received totalling 3,500,000 cu. ft. per min ; a remarkable achievement for an entirely new type of filter. Units are operating in a great variety of installations and places throughout Britain and many enquiries are being received from overseas. The enormous volume of air involved means that approximately 10 miles of filter material will be employed, from a single unit to one composite installation for the textile industry totalling 240 feet in length.

Among the many industries using the filter is paint manufacturing.

LARGEST SILICON RECTIFIER IN USE FOR CHLORINE PRODUCTION

WHAT is believed to be the largest silicon rectifier equipment made in this country to date has been completed by Westinghouse Brake and Signal Company Ltd. It is being shipped to India to provide current for electrolytic cells producing chlorine and caustic. The rectifier plant using silicon diodes made in the Chippenham works of Westinghouse, is rated at 27,500 amp at 60 - 120 V d.c., and comprises a regulator and transformer connected to the 22kV system, a water-cooled silicon rectifier, and a control cubicle with automatic adjustment of the direct current, so that the rate of production of chlorine is maintained constant. The rectifier needs a floor space of only 57 sq. ft.



The compact design of the Westinghouse silicon rectifier is illustrated by this 14,000-ampere 120-V cubicle which occupies a floor space of 4 ft. 6 in. x 12 ft. 8 in.

MEETINGS OF THE MONTH

February 18

Institute of Vitreous Enamellers (Midland Section). "Jewellery enamelling," by Mr. Ore at the Station Hotel, Dudley. 7.30 p.m.

March 2

Institute of Vitreous Enamellers (Southern Section). Annual General Meeting, followed by "Some Fundamentals on the preparation and usage of Sheet Iron Ground Coat Enamels" by A. I. Blackburn, at the Howard Hotel, Norfolk Street, W.C.2. 7.15 p.m.

March 3

Institute of Metal Finishing (North-west Branch). "Sequestering Agents in Plating," by T. K. Aiken, at the Engineers Club, Albert Square, Manchester. 7.30 p.m.

March 4

Institute of Vitreous Enamellers (Midland Section). Annual dinner, at the Station Hotel, Dudley.

Society of Chemical Industry (Oils and Fats Group). "Recent advances on fat stabilization," by N. Uri, at the Royal College of Science and Technology, Glasgow, C.1. 7.30 p.m.

March 7

Society of Chemical Industry (London Section). "Recent advances in the chemistry and industrial applications of hydrido- and organoboron compounds", by Dr. W. Gerrard, in the Society's rooms, 14, Belgrave Square, London, S.W.1. 6.30 p.m.

March 9

Institute of Metal Finishing (Organic Finishing Group). "Inspection and testing of organic finishes," by R. J. Brown, at the British Institute of Management, 80, Fetter Lane, London, E.C.4. 6.30 p.m.

March 14

Society of Instrument Technology (Liverpool section joint meeting with the Society of Chemical Industries). "Automatic titrators and related equipment," by D. A. Patient, at the M.A.N.W.E.B. Industrial Development Centre, Paradise Street, Liverpool. 7.15 p.m.

March 15

Institute of Metal Finishing (South-west Branch). Annual General Meeting and "Bright Anodizing of Aluminium" by G. E. Gardam, at the Royal Hotel, Bristol. 7.30 p.m.

Trade and Technical Publications

Midland Silicones, Ltd., 68, Knightsbridge, London, S.W.1., have published a technical booklet describing their cold curing silicone rubbers. The rubbers, made in three grades, have been developed at the Midland Silicones plant at Barry, Glamorgan.

An advantage claimed for these products is that they need no heat cure : the addition of a small quantity of catalyst converts the base material at room temperature into heat-stable rubbery products. No special equipment or skill is needed.

The booklet " Cold-Cure Silastomer " describes in detail the properties of these rubbers, explains how they are processed, lists established uses and suggests many more. The publication is well illustrated and has several tables listing properties.

* * *

A comprehensive catalogue has been issued by Escol Products Ltd., Paisley Works, Swains Road, Tooting Junction, London, S.W.17., describing the products they manufacture for all enamellers. These range from the well-known Escol frits and other compounds, tools, rubbing down and preparation equipment, weighing machines, pickling room and shot blast equipment, air compressors, spray booths, perrets and jigs, ventilation equipment, separators, spraying equipment, process timers, and finally protective clothing.

* * *

A new publication from the general chemicals department of Albright and Wilson (Mfg.) Ltd., 1, Knightsbridge Green, London, S.W.1., lists close on 400 products in frequent use by the department detailed in alphabetical order ; a brief description of physical form and the nature of the packs the products are available in is useful additional information.

* * *

A new catalogue for Dixylon plastic transmission belting for high-speed drives has been published by R. and J. Dick Ltd., Greenhead Works, Glasgow, S.E.

The catalogue describes in detail belts that will operate at velocities of 10,000 ft. per min. and gives much useful information on belt thicknesses, co-efficients of friction and horse-power rating per width of belt, for example.

The performance of the Dixylon belt is said to be unaffected by humidity, dryness or dust provided these factors are taken into account when calculating the initial belt tension. Belting designed for use in industries where belt drives operate in the presence of inflammable vapours and explosive dusts, and an oil-resisting belt, are also described.

News Bulletin No. 1 from Anti-Dust Services Ltd., describes the new Taccy doormat, suitable for doorways into airlocks, dust-free enclosures and rooms. The makers say that in stepping off the mat onto white copy paper no soiling is evident, nor is any sticky residue left on the shoes, although crepe soles will pick up the impregnation used. Available from the company at P.O. Box 28, 53a, Stafford Street, Dudley, Worcs.

* * *

A leaflet published by Jenolite Ltd., 13—17 Rathbone Street, London, W1. provides technical data and suggested applications for " Sol-Speed Dri," an all-purpose oil and grease-absorbent. The makers suggest that among its many other uses it can be used as a drying medium for articles after plating.

* * *

A recent issue of The Bonderizer carries as its main article a description of the company's " Endurion " process in use at the works of B. J. Round and Sons Ltd. The treatment is said to impart exceptional rust resisting qualities to a " Parkerized " steel surface, with a minimum of dimensional build-up and improved qualities of wear resistance to the surface finish. The resultant coating can also be dyed to provide a ready colour guide for storage reference.

Prior to using the process, three baths were used for " Parkerizing," comprising the usual sequence of degrease, rinse, pickle, rinse, " Parkerize," rinse and dry off. To include the " Endurion " seqeuence, three additional baths were provided, the first containing the solution followed by hot and cold rinses. The work then proceeded to the usual " Parker " and oil finish. The resultant " Endurion " treated coating has been found to be entirely satisfactory it is said, standing up to a rigorous gruelling in a 20 per cent continuous salt spray at an elevated temperature for upwards of 40 hours.

* * *

Summary tests and a formulation for a new red lead-coumarone primer for seawater immersion are published in Red Lead Technical Letter No. 14, available from the Lead Industries Association, 60, East 42nd Street, New York, 17, N.Y. In addition to the primer, the publication describes complete paint systems for ship hulls and fixed marine installations.

The primer makes use of a red lead mixed pigmentation in a vehicle built around coumarone-indene resins. Recommended practice calls for a dry film thickness of 5 mils—which can be achieved in two or three coats. The primer can be applied to sandblasted metal or over a pretreatment coat. Normally it is followed by an antifouling coat to discourage marine growth. Several such coatings are described or mentioned in the technical letter.

* * *

A new " Metallizing Handbook " covers techniques and developments in flame spraying. It is written for owners and operators of metallizing equipment and for design, production and maintenance engineers. The book is in two parts covering standard practices and developments in metallizing and forms a complete reference handbook on flame spraying. Part one is devoted to wire metal spraying and part two contains the latest information on the powder process. Metal spraying and ceramic spraying are each dealt with in great detail and a section is devoted to the latest techniques in the application of hard-facing materials, including Tungsten Carbide. The book is available from Metallizing Equipment Co. Ltd., Chobham, Woking, price 35s. 10d. post paid in the U.K.

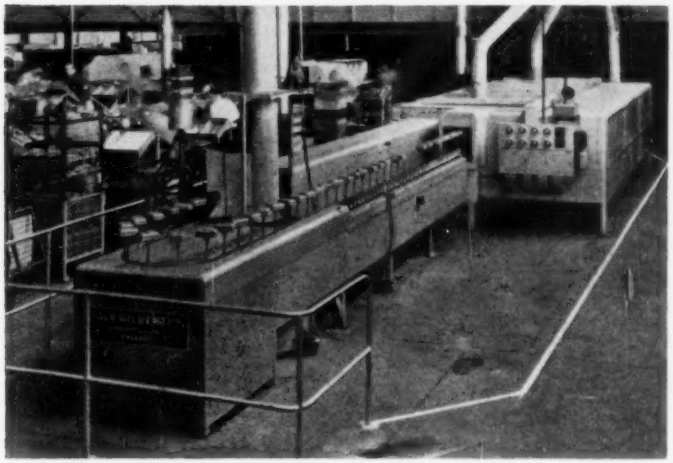
* * *

Honeywell Controls Ltd., Ruislip Road East, Greenford, Middlesex, have issued a brochure illustrating the wide range of millivoltmeters produced by them. For those interested in maintaining their own instruments, this firm conduct a tuition-free Instrumentation School in London.

OBITUARY

Parrott : Mr. Arthur John Parrott who had been joint managing director of Heat and Air Systems Ltd. for 20 years died suddenly on January 13, 1960 at the age of 74. Mr. Parrott had been a director of the company since its incorporation in 1935 and had spent the whole of his working life in the heating and ventilating industry.

RADIANT STOVING INSTALLATION FOR SWITCHGEAR



A NEW electric radiant stoving installation for a Midlands electric switchgear manufacturing company has recently been built by G. & R. Gilbert Ltd. of Hackbridge.

The stoving unit is designed to link with an automatic spraying machine and is for the continuous finishing of switch and starter cases and lids at rates of from 960 to 1920 per hour depending on the size, since in the case of the largest items only alternate workholders are used.

The workpieces, after leaving the automatic spray machine, pass through an enclosed flash-off tunnel, before entering the stoving chamber, which is heated by electric radiant emitters arranged in the top with auxiliary reflectors only below the work-pieces. This arrangement provides for uniform overall stoving effect on the deep pressed sections involved. Full thermal insulation of the stoving space retains the maximum amount of heat within the oven promoting a high level of efficiency, the unit being, in fact, designed to operate on as little as 27 kW full heat load.

The stoved parts, on leaving the oven, pass through a forced-air cooling tunnel, where the temperature is lowered to aid the handling of the component parts when they are unloaded. The design is such that the conveyor, which is in the form of a roller chain, with support skates carrying the actual work load, is protected from heat so far as possible, by allowing the workholders only to pass through a continuous slot in the insulated floor. The conveyor is automatically tensioned and all the conveyor shafts are carried in special self-aligning bearing assemblies which are sealed and require no subsequent lubrication.

Among the many refinements incorporated in this oven is a centralized control panel, large access panels to the oven enabling emitters to be changed quickly and easily, inspection in the stoving chamber which allow the progress of the work to be observed, panelling to the supporting framework to provide for a clean and neat appearance, and the running of all heater cables in easy access trunking.

Canadian Paint President Visits U.K.

CYRIL H. Neroutsos, D.S.O., newly-elected president of the Canadian Paint, Varnish and Lacquer Association, and also President of International Paints (Canada) Ltd. recently paid a 10-day visit to Britain. He discussed with International Paints headquarters in London the setting-up of a new manufacturing plant in Canada's mid-West.

International Paints (Canada) Ltd., already has plants in Montreal and Vancouver.

Change of Telephone Number

OWING to the continued expansion in business of Electropol Processing, Ltd., Trading Estate, Farnham, Surrey, it has become necessary to increase the number of telephone lines serving the works and offices. This has involved a change in number to Farnham 3355.

HONOUR FOR SIR ERNEST CANNING

AT the Head Office of W. Canning and Co. Ltd. recently, a bronze plaque was unveiled by the chairman, Mr. F. H. Ewens, F.C.A., depicting the head and shoulders of Sir Ernest Canning, D.L., J.P., president of the company. In the course of the ceremony Mr. Ewens said that to mark Sir Ernest's 66 years' association with the company two scholarships had been created at Birmingham University, one in the Department of Chemistry and one in the Department of Industrial Metallurgy. The plaque would stand as a permanent record of his life's work to future generations.

Technical & Industrial Appointments

The appointment of Captain R. A. Villiers, C.B.E., A.M.I.E.E., R.N. (Retd.) as the first Director of the **Scientific Instrument Manufacturers' Association of Great Britain,** SIMA House, Queen Anne Street, London, W.1., was the major step in the administrative reorganization of SIMA and the beginning, also, of a new era of expanding activities, increased national and international effectiveness and a serious drive for increased membership to enable the Association to represent the scientific, electrical, electronic and nucleonic instrument industries with greater authority still.

To facilitate this aim, Mr. G. L. Knight has been appointed assistant to the director of SIMA. He will operate under Captain Villiers in the field of information and external activities in particular, and will also be responsible for the collection and distribution of information for SIMA. Mr. Knight is available to answer all general questions at SIMA House (Langham 4251). The Instrument Enquiry Service is still at Imperial 6000.

* * *

Borax and Chemicals Ltd., 35, Piccadilly, London, W.1. have announced that sales manager, Mr. H. F. Barnett, and secretary, Mr. W. C. Steer, having reached retirement age, have relinquished their duties with the company. Mr. Barnett and Mr. Steer have held their positions since its inception twenty-one years ago and have been concerned with the sale and distribution of " Three Elephant " brand products for well over thirty years.

Mr. P. J. Gilbert, who was for over five years representative in the Midlands, will succeed Mr. Barnett and Mr. B. W. Green, who joined the company's head office staff in 1951 will succeed Mr. Steer.

* * *

K. W. Sims has been appointed export promotion manager of **C. C. Wakefield and Co. Ltd.,** parent company of the Castrol Oil Group.

Kenneth Sims, who is 39, joined the company in 1951 as an industrial oils sales representative. In 1954 he was transferred to the overseas division and posted to Cyprus as resident manager, middle east. Three years later, he returned to headquarters and was then attached to the Group's American subsidiary, Castrol Oils Inc., as sales manager. His latest promotion follows the conclusion of this appointment.

Mr. Sims is a member of the Junior Institution of Engineers, an associate fellow of the Institute of Petroleum and an associate member of the Society of Automotive Engineers of America.

* * *

Electro-Chemical Engineering Co. Ltd. announce that Mr. A. W. Graham has been appointed Manager, Northern Area in succession to Mr. H. Maxwell. His address will be : Chaddock Industrial Estate, Astley, nr. Manchester. Tel : Atherton 1364.

Mr. Maxwell has been appointed Sales Manager and will be operating from the Company's head office at Sheerwater, Woking, Surrey.

* * *

The appointment of Mr. Edw. E. Hewett as sales engineer is announced by **Nash and Thompson Ltd.,** of Hook Rise, Tolworth, Surbiton, Surrey.

Mr. Hewett, who is a member of S.O.N.D.E., was previously a specialist in ultrasonic flaw-detection techniques at Cossor Instruments Ltd. and is now responsible for the Nash and Thompson sales of the KOVO polarographs and electron microscope throughout the United Kingdom. plus metallurgical, electronic test equipment, process control, medical and survey instruments in the counties of Essex, Middlesex, Herts, Suffolk, Norfolk, Cambridge, Hunts, Beds, Bucks, Oxford, Gloucester, Shropshire and all Wales.

The previous appointments in the Cossor Group held by Mr. Hewett included head of test engineering department, radar division, in charge of radar test specifications department and radar development engineer.

* * *

At a recent meeting of the board of directors of **Detel Products Ltd.,** Mrs. Vivienne D. Johnson was appointed managing director. Mrs. Johnson has been with the company for 20 years, being secretary since 1941, and a director since 1949.

The premises of the Company are shortly to be extended in order to permit increased production and to give more space for research facilities.

* * *

As plans for the merging of the resources of **Reynolds T. I. Aluminium Ltd.** with **The British Aluminium Co. Ltd.** are now well advanced, the following changes of appointments are announced. Pending completion of the plans, the new appointments will cover the operations of both Companies.

A. W. Graham

Mr. Gerald Lacey : commercial director, The British Aluminium Co. Ltd. : to be executive director (forward planning) with special responsibility for studying and co-ordinating long-term planning for the development of production, fabrication and research interests in the U.K. and overseas.

Mr. G. A. Anderson : director and general sales manager, the British Aluminium Co. Ltd. : to be director of products and development with responsibility for the products, development and technical service organizations.

Mr. Basil James : chief executive (sales), Reynolds T.I. Aluminium Ltd. : to be director of sales with responsibility for the sales, publicity and marketing organizations.

Mr. J. Salter : director and general production manager, The British Aluminium Co. Ltd. : To be director of engineering with responsibility for civil, mechanical and electrical engineering with responsibility for civil, mechanical and electrical engineering and building work at U.K. and overseas establishments.

Mr. Paul R. McGehee : chief executive (production), Reynolds T.I. Aluminium Ltd. : To be director of production (manufactured products) with responsibility for operations at the company's mills and associated establishments.

Mr. W. B. C. Perrycoste : director and general production manager, The British Aluminium Co. Ltd. : To be director of production (primary products) with responsibility for mining, alumina production and aluminium smelting operations at U.K. and overseas establishments.

* * *

Sir David Eccles, Minister of Education, has appointed Sir Harold

(*Continued in page* 75)

Technical and Industrial Appointments

(*Continued from page* 74)

Roxbee Cox, PH.D., D.I.C., D.SC., M.I.MECH.E., F.R.AE.S., F.INST.F., F.I.AE.S., as chairman of the **National Council for Technological Awards** in succession to Lord Hives, who has retired. Sir Harold has been vice-chairman of the National Council since its establishment in 1955.

Sir Harold Roxbee Cox, formerly Chief Scientist, Ministry of Fuel and Power, is Deputy Chairman and Chairman-elect of the Metal Box Co. Ltd., and a director of Wilmot Breeden (Holdings) Ltd., and of Boulton Paul Aircraft Ltd. He is also a vice-chairman of the Council of the Air Registration Board, vice-chairman of the Governors of the College of Aeronautics, and a member of the Council for Scientific and Industrial Research.

Sir Harold was educated at Kings Norton Grammar School, Birmingham, and the Imperial College of Science and Technology. He was closely associated with the construction of the airship R.101 and with Sir Frank Whittle in the development of jet propulsion and gas turbines. Sir Harold is married, with two sons, and his publications include numerous papers on aerodynamic s gas turbines and civil aviation.

Continuous Tiling System Exhibition

IN order to acquaint local interests of the advantages of the Correnda " continuous tiling " system for walls and ceilings, Corrosion Limited announce that they have arranged an exhibition at the Midland Hotel, Manchester, from Monday, February 15 to Friday, February 19, 1960, inclusive.

The recent introduction by the company of their Correnda " continuous tiling " system has been followed by an immense amount of interest from those concerned with the upgrading of wall and ceiling surfaces from the point of view of hygiene and resistance to high humidity.

There is a growing body of opinion that glazed tiles are no longer acceptable for those locations where a high degree of hygiene is required, as, for example, in hospital operating theatres and in food manufacture. While the tiles themselves are excellent, there is a danger of infection in the joints and in the cracks that develop in them after a period of use. Hence the great interest in Correnda, which is a solid lining applied without any joins.

NEW COMPANIES

" Ltd " is understood also " Private Co." Figures = Capital, Names = Directors, all unless otherwise indicated.

Whitleys (Metal Engineers), 20/22, Potters Lane, Aston, Birmingham, 6. December 9. £500. To carry on bus. of metal and alloy makers, etc. Frank Gumbley, Gwendoline Gumbley.

Mechanical Joints (Birmingham), 141/147, Lionel Street, Birmingham. December 10. £100. To carry on bus. of iron-founders, mechanical engineers, machinery manufacturers, etc. Francis W. N. Duffield, Patrick J. H. Riley, Alfred T. Bowater.

Qualcom, 68 Manor Road North, Hinchley Wood, Esher, Surrey. December 10. £100. To carry on bus. of manufacturers of and merchants of plastic metal moulded electronic and general engineering components, etc. Alexander Briggs, Mrs. Rita Briggs.

Alcan (U.K.). December 14. £500,000. To carry on bus. of principal, or as agent, commission merchant or consignee, the bus. of purchasing, importing, exporting, selling or supplying aluminium or any other metal, etc. Directors not named.

Jack Summers (Huddersfield), 52, Greenhead Lane, Dalton, Huddersfield. December 15. £2,000. To carry on bus. of iron and steel stockholders and merchants, metal finishers etc. Jack Summers, Maisie Summers.

Roxbee Heating, 51 Coleman Street, E.C.2. December 17. £1,000. To carry on bus. of heating, ventilating, fire protection experts and advisers, stove and range manufacturers, etc. Harold R. Cox, Christopher W. R. Cox, Gordon C. Collins, Edgar R. Rapkin.

Rigidized Metals, 159, Stoke Newington High Street, N.16. December 18. £1,000. Harry W. Childs, Keith Childs.

Briere (London), 56, Victoria Street, S.W.1. December 21. £100. To carry on bus. of crane and metal workers, etc. Gerard R. V. Briere, Josjane J. A. Briere.

James Booth Aluminium, Argyle Street Works, Nechells, Birmingham, 7. December 21. £100. To acquire the whole or part of the business of James Booth and Co. Ltd., which consists of the manufacture of wrought aluminium alloys and other aluminium products, etc. Directors not named.

Western Steel and Non-Ferrous Metal Stockholders, Sloper Road, Cardiff. December 21. £1,000. Charles F. Heald, Samuel C. Kellow, Arnold G. Kyrke, Charles L. Field.

Metal Polishers (Glos.), North Place, Cheltenham. December 28. £1,000. Directors not named.

Metal Processes (1959), 130, Floodgate Street, Birmingham, 5. December 28. £100. To carry on bus. of chemical processes and colouring of metals, etc. Leslie Deathridge, Myer Cooper.

Croda, Cowick Hall, Snaith, nr. Goole, Yorks. December 31. £50,000. To acquire the whole or such part of the trading undertaking, plant, machinery and assets of The Croda Organization, Ltd., and to carry on bus. of manufacturers of and dealers in grease, oils, lubricants, paints, varnishes, etc. Croda Organization Ltd., Frank A. S. Wood.

Upsil, Marshgate Lane, Stratford, E.15. December 31. £100. To carry on the purchase, sale and distribution of chemical products, metal alloys, etc. Paul Gignoux, Pierre H. A. Bourgois, Kingley Williams, Antony Weil, Jean-Jacques C. Baron, Charles A. Roy.

From the Register compiled by Jordan & Sons Ltd. 16 Chancery Lane, London, W.C.2.

Instrument Manufacturers Expand

IT is announced that Nash and Thompson Ltd. have acquired a second factory at Hook Rise, Tolworth, within 200 yards of their present research and production unit in Oakcroft Road, Chessington, Surrey. This new factory has increased the available space by 35,000 sq. ft. and the transfer of administrative departments, research and development and some production departments has now been completed. The purchase of this property was made necessary by the continued expansion of production and development during the last few years.

IDEAL HOMES EXHIBITION

THE " Daily Mail " Ideal Home Exhibition will be held this year at Olympia, London, from March 1 to 26.

TECHNICAL BOOKSHELF

Handbook on Electroplating. Birmingham, 1960. W. Canning and Co. Ltd., Great Hampton Street, Birmingham 18. 631 pp. 30s. net.

This, the nineteenth edition of the well-known "Canning Handbook" has been considerably revised and enlarged. The sectional order has been brought into line with modern practice and the book is now divided into three main sections : polishing ; electroplating ; bronzing and lacquering. Cleaning and pickling, which form an integral part of any electroplating process, are now included in the electroplating section, and under polishing are grouped the various mechanical finishing processes, including abrasive finishing, polishing, and wire brushing. Chapters are also included on electrolytic and chemical brightening of metals and on effluent treatment. In addition, control standards are given for the various plating processes described.

In the electroplating section the first three chapters cover the necessary equipment, while the fourth deals with the general principles of the process. Although not intended to be an exhaustive study of the theories underlying electroplating processes, it will give those concerned with their practical application sufficient background knowledge for their day-to-day needs. Completing this section are chapters on pretreatment processes and detailed information on a wide range of plating deposits.

Previous editions of this book have been a part of the library of all connected with electroplating for many years, and this new edition, even more valuable in its enlarged form, will perpetuate this tradition.

TURKEY ORDERS BRITISH PAINT

THE largest order of its kind ever to be placed in this country by the Turkish Government, and worth not far short of 200,000 dollars, has gone to International Paints Ltd. The order is for 352-tons of bottom paints (antifouling, anticorrosive and boottoping). The deal was handled by Denizcilik Bankasi—a Turkish Government body owning approximately 90 per cent of the Turkish Mercantile Marine.

The quantity is equal to 63,000 gallons—sufficient to cover 3,200,000 square yards of any paint area and is said to be enough to meet the customer's requirements for 18 months.

Fume Duct Treated with Rigid P.V.C.

A NEW fume ducting installed for Serck Tubes Ltd., Birmingham, by Tanks and Linings Ltd., Droitwich, to the order of Newton Collins Ltd., is made from rigid P.V.C. throughout.

The ducting handles fumes from sulphuric-acid pickling tanks and is fully resistant to the highly corrosive gases and will not require any maintenance or external painting. The discharge chimney is 36 in. in diameter and the cowl assembly measures 5 ft. 6 in. diameter x 8 ft. high.

PAINT MANUFACTURERS HAVE RECORD YEAR IN 1959

SALES during the year 1959 were the best in the history of Blundell, Spence and Co. Ltd. it was announced by Mr. E. B. Calvert, chairman and managing director, at the Annual Sales Representatives' Conference held in London recently. This was the first occasion at which the industrial division was represented following the integration of John J. Bowater Ltd. and Vulcan Products Ltd.

"Prospects for the industry as a whole are looking up," continued Mr. Calvert, "despite the slight drop in retail sales due to the fine summer".

The company was fortunate in having the technical support of The Dunlop Rubber Co. Ltd., which produces the special grade of Polimul on which Pammastic is based. Links between the two companies had been still further cemented during the year.

Commenting on the Company's distribution system, Mr. Calvert said that no major changes were contemplated. However, a heavier attack on the retail market was proposed, at the same time increasing the number of main distributors in certain areas.

Turning to the Industrial Division, Mr. Calvert said that the Slough factory was now working smoothly. Sales of transport and industrial finishes had increased. Existing local depots would stock these as well as decorative finishes.

Also speaking at the conference was Mr. C. L. Blackman (Home Sales Manager, Decorative) who reviewed the advertising and marketing plans for Pammastic and Pammel for 1960.

In addition to national and local press and TV advertising, the Company would be represented at the Ideal Homes and other exhibitions. Following the success of the 1959 Pammastic demonstrations, nine had been arranged during the winter.

Considerably more display material would be available in the New Year.

Other speakers at the conference were Mr. C. C. Mell (Divisional Director), Mr. A. J. Ford (Chief Chemist, Decorative Division), Mr. C. F. Burgess (Home Sales Manager, Industrial Division) and Mr. W. H. Tatton (Technical Manager, Industrial Division).

CATHODIC PROTECTION Special Panel of Corrosion Group of S.C.I. to be set up

THE committee of the Corrosion Group of the Society of Chemical Industry considers that an attempt should be made to provide members whose predominant interest is cathodic protection with more frequent opportunities to discuss research and development in their field of work. On the other hand, the committee wishes the subjects included in the general programme of Group meetings to remain as varied as possible and does not expect to be able to increase the frequency at which any aspect of cathodic protection appears in it.

It has been suggested, therefore, that a Cathodic Protection Panel of the Group should be formed to have its own officers and programme. Such an arrangement would permit more meetings to be held without affecting the balance of interests in the Group programme. It should also, by gathering an audience wholly knowledgeable in the subject, encourage discussions both more informal and more detailed than those possible in general meetings.

Those who would like to become members of a Cathodic Protection Panel are invited to inform Mr. C. S. Britton, Hon. Secretary, Corrosion Group, c/o Tin Research Institute, Fraser Road, Greenford, Middlesex, not later than February 29. If a sufficient response is obtained a meeting will be called to make preparations for the Panel to operate in the 1960/61 Session. Additional comment in writing will be welcome.

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Copolymer Resin Paint

TRAFFIC marking paint formulated by Sandstrom Products Company of Port Byron, Illinois, U.S.A. is being used at the Quad City Airport in Moline, Illinois.

Based on Pliolite VT, a solution resin recently introduced by the Chemical Division of the Goodyear Tyre and Rubber Co., the markings are said to be in excellent condition after more than 17 months of service.

In addition to traffic paint application, Pliolite VT finds widespread use in multi-colour paints and shows promise in the metal priming and industrial enamels field. The resin also is utilized in paper coatings, printing inks, adhesives and abrasion-resistant coatings.

Pliolite VT is a thermoplastic, copolymer resin developed specifically as a solution binder for coatings. One of the outstanding features of the resin is complete solubility in aliphatic solvents ; in addition, it is colourless, tasteless and produces film of unusual clarity, strength and hardness, it is claimed.

The Goodyear resin can be included in the general class of lacquers because film formation is achieved by results from solvent evaporation. Drying time, therefore, is dependent only upon the volatility of the solvent system used.

Mechanical Finishing Using a Vibratory Motion

THE Roto-Finish Co., Kalamazoo, U.S.A. are now marketing a range of metal-finishing machines in which a vibratory motion in place of the rotary action of the conventional-type barrel is employed. It is claimed that the new process has advantages over the conventional system in many aspects. The following are said to be the advantages.

It is claimed that the new system is 4 to 6 times faster than the rotary barrel. The reason for this increased efficiency is that in conventional barrelling the abrasive action takes place in a sliding zone several inches deep extending the width of the rotating cylinder. Beneath the zone, little or no relative motion takes place between the components and the processing media, the mass being carried around in a position of repose until the point is reached where it commences to slide.

With the new vibratory system, the container holding the mass is subjected to a 3-way vibration which produces an overall rotary motion of the whole mass, and, at the same time, movement of the individual chips in random directions. As the movement zone extends throughout the entire

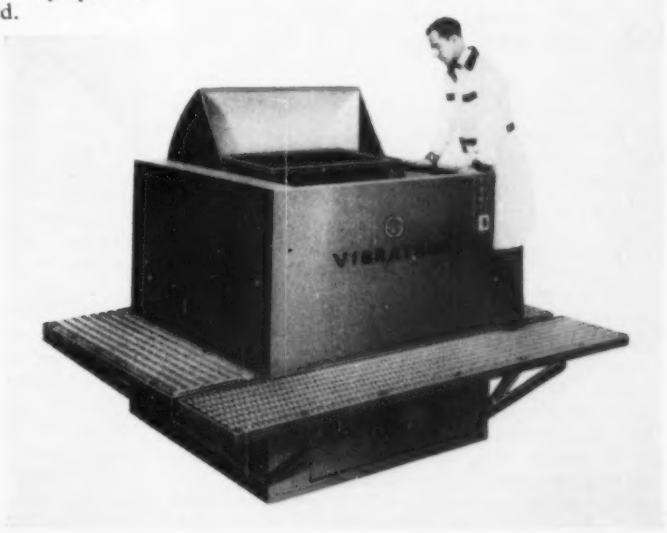


Fig. 1.—A 7-cu. ft. capacity mechanical finishing unit.

mass, work is said to be accomplished much more rapidly.

Internal surfaces are treated as rapidly and as effectively as external surfaces. The vibratory system, with its 3-way movement of the chips, ensures that the media can flow through cavities at the same rate as over external surfaces.

Larger work loads relative to capacity can be accommodated in the new type machines. This is due to a number of factors, the main one being that, as less impingement is caused, fewer chips are necessary for cushioning purposes. Thus a greater work load can be accommodated per overall cubic capacity of a machine.

The machines have an open head container so that visual control of progress and process is possible. A single component can be taken from the plant, while in operation, for immediate visual inspection and then dropped back.

"Continuous flow" processing, where the parts emerge at the same speed at which they enter, can be arranged without difficulty.

Fig. 1 illustrates a 7-cu. ft. capacity Vibratron. It is one of a range of four machines, with capacities from 1 to 7-cu. ft., produced.

The development engineers of Roto-Finish Ltd. (Gt. Britain), Mark Road, Hemel Hempstead, Herts., have been working for some time on the development of a range of vibratory action machines with features and capacities suitable to European industries. They are also developing a 2-tank vibratory machine which it is claimed has further advantages over the single-tank type.

Translucent Polycrystalline Ceramic

A NEW ceramic material claimed to have a unique combination of properties has been announced by the U.S. General Electric Co. Schenectady, N.Y. (Fig. 2).

It is said to be a polycrystalline ceramic that readily transmits light, and is made from powders. In addition to transmitting light, the new material is claimed to possess the high strength characteristic of alumina ceramics, can withstand higher temperatures than most ceramics now in use, and can be pressed into any shape desired.

" Lucalox," as the material is named, is made from powdered aluminium oxide. It is closely related to sapphire and ruby gem stones, which are single-crystal aluminium oxide. But the new polycrystalline form of the compound is said to be superior to these gems in its ability to withstand high temperatures without deforming. Lucalox has the composition of a ceramic, the structure of a metal, and the light-transmitting ability approaching that of glass, the company says.

The unique characteristics claimed for Lucalox are said to result from the fact that the microscopically small pores, or " bubbles," normally found in ceramic materials have been entirely removed, a feat that had been previously considered impossible.

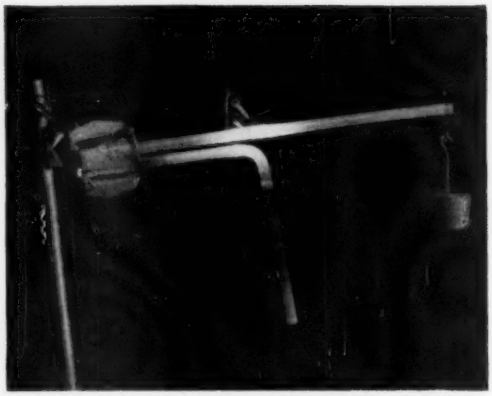


Fig. 2—A bar of translucent polycrystalline ceramic.

The basic material of Lucalox is fine-grain, high-purity aluminium oxide, or " alumina." The powder is pressed at room temperature, then fired at temperatures that are higher than usual for ceramics. The problems of making the process commercially feasible are being explored.

It is thought that the development of Lucalox should greatly enlarge the scientific, military, and industrial uses of ceramics. As has been the case with many new materials, it should also extend the range of instruments and devices that are presently limited by the physical characteristics of available materials. One example would be high-intensity incandescent and discharge lamps, which are now limited by the heat-resistance of their transparent envelopes, in some cases. Fused quartz, which is often used for high-temperature lamps, performs satisfactorily up to 1800°F. Lucalox is said to be stable at temperatures close to 3600°F.

Another likely application for Lucalox is in the banks of infra-red lamps that are used for a variety of industrial purposes. It could also be used as an electrical insulator and as a material for gem bearings in delicate equipment.

Machine for Painting Scaffolding

THE Hunter " Scaffspray " machine is claimed to be able to paint scaffolding at 1,500 ft per hr., using the Hunterseal anti-corrosive process. Rusty and damp tubes can be painted satisfactorily, the makers say, and the machine delivers the painted tubes dry to the hand. (Fig. 3).

Scaffolding can be painted in distinctive colours, thus helping to identify the work of individual contractors, thus reducing losses through misappropriation when sites are cleared. Tubes

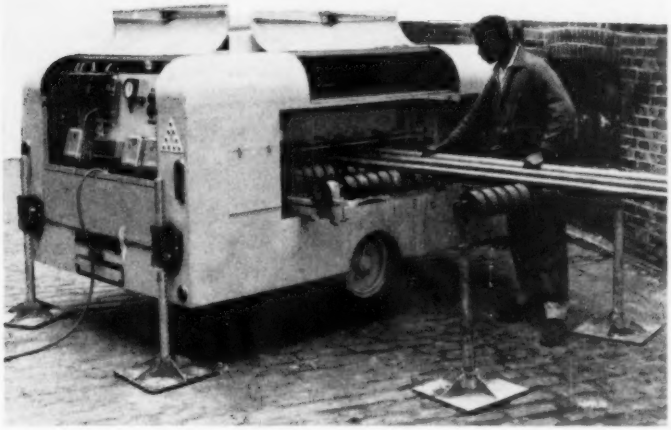


Fig. 3—Machine for painting scaffolding.

from 1 in. to 3 in. dia. and from 4 ft. to 30 ft. long can be treated in the machine.

The Scaffspray is trailer-mounted and is weather-proofed. It can be moved readily from site to site or used as a stationary unit at a plant depot. This mobility allows scaffolding to be painted on the site before erection and after dismantling.

The Scaffspray measures 10 ft. 6 in. long, plus a tow bar of 3 ft. It is 5 ft. 9 in. wide and 5 ft. 7 in. high — approximately. For operation a minimum area of 30 ft. by 90 ft. is required. Power requirement is 440 volts 3 phase, having a load of approximately 25 kVA. Machines can either be bought outright or hired on a time or footage treated basis.

Before painting, the tubes are cleaned in a separate cleaning machine, taking its power from the Scaffspray machine. Each pole is fed individually through the machine, and the cleaning process is in two parts.

First, the pole is flayed by hardened steel flails to remove old concrete and scale. Then the pole passes through wire brushes revolving at high speed. The pole is then fed into the Scaffspray machine, where the anti-corrosive system is applied.

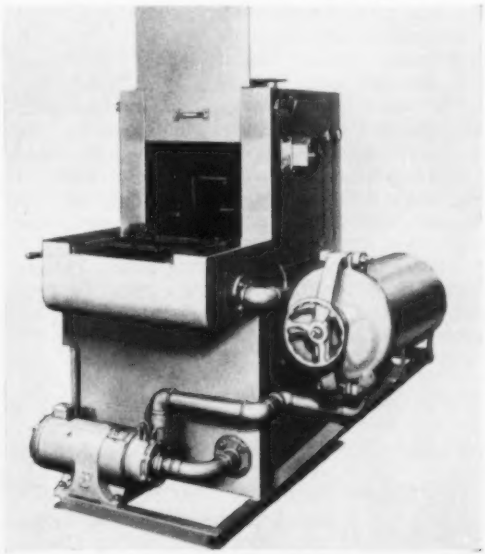
Machines for Cleaning Metal Parts have Nylon Filters

ILLUSTRATED in Fig. 4 is the metal washing machine designed for flows of 100, 200 and 300 gal. per min. and manufactured by Drummond Asquith Ltd., King Edward House, New Street, Birmingham 2.

The machines use a filtration system suitable for the very fine swarfs obtained with modern machining methods for aluminium, cast iron and similar granular materials. The system incorporates a finely-woven nylon fabric fitted over a perforated drum. The alkali solution used in the machine is pumped through this assembly before being fed to the jetting arrangement, and it is claimed that the filtration obtained by this method eliminates the possibility of blocked jets caused by such fine swarfs. The nylon bag can easily be replaced when necessary.

The filters are pressure tested and are available for the range of three sizes of machines mentioned above, at pressures of up to 20 lb. per sq. in.

Fig. 4—Machine for cleaning metal parts.



Portable Barrel Pump

AN air-motor operated unit has recently been added to the range of portable barrel pumps made by the British Central Electrical Co. Ltd., Briticent House, 6 and 8 Rosebery Avenue, London, E.C.1. (Fig. 5). The existing range is already used for the removal of liquids from transit containers, and this new addition will be of particular interest where extremely hazardous conditions are encountered.

The air-motor operates from a 30-120 lb. per sq. in. supply without a reducing valve. The rotary drive is transmitted through an inner tube, fitted with robust bearings and efficient seals, carrying a driving shaft that transmits the rotary motion to the impellor assembly. An outer suction-tube fitted with hose attachment, for 1¼ in. bore hose, allows the liquid to be raised into a standard hose line. The off-load speed of motor and impellor assembly is 16,000 r.p.m. ; on load, 12,000 r.p.m. The consumption of the air motor with such liquids as water is approx. 20 cu. ft. per min. from an 80 lb. per sq. in. air line. The maintenance of the air motor is simple. The oil reservoir requires charging once per day or shift, and it uses readily obtainable lubricants.

The motor can be controlled by a simple handgrip that can be locked in position if desired. The air line attachment is conveniently placed, and prevents the air line interfering with the ease of handling of the unit when transferring from container to container.

The lifting tube sets are detachable, and are easily dismantled for cleaning and sterilising all parts in contact with the liquid. Tube sets are available in two lengths—2 ft. 3 in. and 3 ft. 7 in.—in aluminium alloy; and 2 ft. 3 in. and 3 ft. 11¼ in. in austenitic stainless steel to enable it to be used with foodstuff, acids and other corrosive liquids.

The unit is self-priming, and will operate against full pressure : i.e., when the pump is in use, with the quick-action tap at the end of the hose closed, it will continue to function without harm. It can handle most liquids, and deliver up to 2,000 gal. per hour dependent on viscosity and lifting head. The maximum head is approximately 25 ft.; the maximum viscosity approximately 150 deg. Engler, or SAE 30. Should the pump be overloaded to the stalling condition, no damage will result to the air motor.

Orbital Sander

THE 'Sandswift' orbital sander illustrated in Fig. 6 is being marketed by Wolf Electric Tools Ltd., Pioneer Works, Hanger Lane, London, W.5.

The features include :—Low weight of only 7 lbs. 3 ozs. ; and a continuously rated motor. The operator can work up close to skirting boards, frame, etc., without damage as the orbit area of pad is $\frac{1}{16}$ in. less than body frame. The unit can be placed on its side without waiting for the pad to come to a standstill after switching off.

A sprocket type of paper locking mechansim is fitted making it quick and easy for operator and giving a positive automatic paper tension. The 3⅜ in. x 7⅛ in. pad for convenience of use and satisfactory results is fitted as standard.

(*Continued in page* 82)

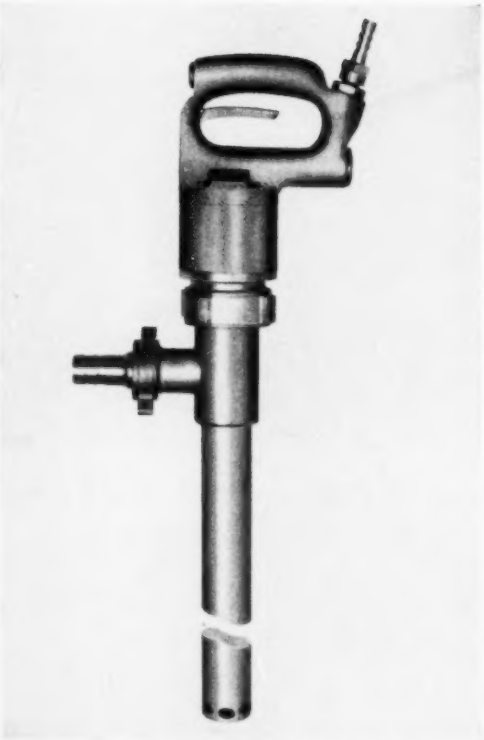


Fig. 5.—*A pneumatic barrel-pump.*

Fig. 6.—*Wolf's newly marketed sander.*

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Plusbrite bright nickel plating provides high ductility, excellent levelling, low internal stress, good receptivity to chromium plate and good colour. Plusbrite addition agents are not removed by continuous filtration and they are easily controlled.

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W 633

Fig. 7.—Spray guns for vitreous enamel (left) L 200, (right) L 1900.

Spray Gun for Vitreous Enamel

THE use of vitreous enamel today is steadily increasing and any improvement in technique which leads to a reduction in production costs is of major importance to the industry.

Following tests and development work in conjunction with Ferro Enamels Ltd., Alfred Bullows and Sons Ltd., Long Street, Walsall, have produced equipment for applying vitreous enamels at very low air pressures (Fig. 7).

This technique of low-pressure enamel application offers several major advantages to the enameller. First, the manufacturers claim a definite economy in enamel used. Second, with a low-pressure nozzle it is a simple matter to obtain a very fine coat, which, when fired, is far less brittle than a thick enamel coat would be. Third, the low-pressure technique requires far less skill than normal production methods. Finally, when spraying hollow objects, such as bread bins, spin-dryers, bowls etc., " bounce " is a serious problem at normal pressures.

Suitable nozzles have been developed for this purpose on the L1900 Bullows-Binks Model 19 and the L200 Model 2 spray guns. When using the L1900, best results are obtained with fluid pressures varying between 5 and 12 lb. per sq. in. and with an air pressure of 25 lb. per sq. in. With the L200 a fluid pressure of 5 lb. per sq. in. and an air pressure varying from 25 to 50 lb. per sq. in. can be used.

The material used for all tests was a standard cover coat enamel having a specific gravity of 1.34 and a fineness of $3\frac{1}{2}/200/50$.

A parallel development resulting from these tests was that, while mottling in the vitreous-enamel trade has generally been considered a slow process, a significant increase in speed is claimed using the L200 spray gun with a fluid pressure of 5 lb. per sq. in. and air pressure of 8 lb. per sq. in.

Ultrasonic Degreaser

THE Model AC-25 Sonogen, built by Branson Ultrasonic Corporation (Stamford, Conn.), is a new self-contained ultrasonic degreaser in a compact, stainless-steel cabinet (Fig. 8).

Fig. 8.—Ultrasonic degreasing equipment.

The unit removes metal chips, grease, and certain insoluble soils, from intricate parts. Components such as small motors, electronic sub-assemblies, and bearings can be ultrasonically cleaned without dismantling.

After immersion in the ultrasonic degreasing tank, work is spray-rinsed by hand, placed in the vapour zone, then removed from the unit clean and dry.

Measuring 44 in. x 18 in. x 36 in., the Model AC-25 can be easily installed in any shop or plant. Only water and electrical connexions are needed.

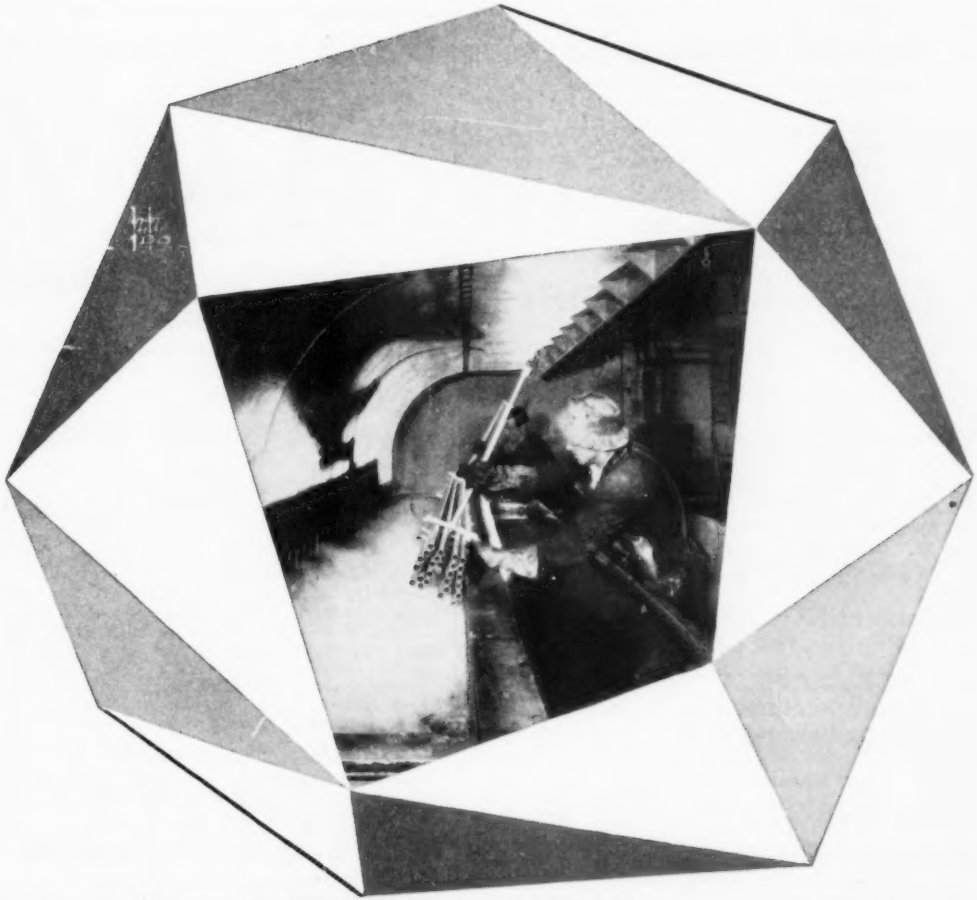
As a guard against corrosion, all degreaser parts in contact with solvent are made of stainless steel or TFE plastic.

The degreaser has five main components : a 10 in. x 8 in. x 8 in. deep ultrasonic cleaning tank; a boiling sump; an ultrasonic generator producing 40,000 cycles per sec.; transducers (in the cleaning tank) that convert the electrical energy into mechanical vibrations; and a system to recirculate filtered solvent.

A variety of fail-safe features protect the unit. A water-cooling system limits evaporation loss, and an automatic interlock shuts off the sump's strip heaters if the cooling system fails. Absence of liquid in the cleaning tank stops the ultrasonic generator to keep the transducers from overheating.

To protect the operator against high voltage, another interlock shuts off power when the cabinet access door is open.

More information on the Model AC-25 Sonogen and other ultrasonic cleaning equipment is available from Branson Ultrasonic Corp., 40 Brown House Road, Stamford, Conn., U.S.A.



The largest **PHOSBRITE** *plant in Britain*

Installed at the Birmingham plant of Haynes, Ford & Elliott Ltd is the largest Phosbrite plant in Britain. The 600 gallon tank is particularly interesting not only for its size but also because of the variety of items being chemically polished – from wheel discs to curtain rails – from wash boiler tubs to decorative light fittings. This plant proves without doubt that *CHEMICAL POLISHING WITH PHOSBRITE SOLUTIONS SAVES TIME & MONEY.* Phosbrite 159 for Aluminium and its Alloys. Phosbrite 183 & 184 for Copper and its Alloys Phosbrite 501 for electrolytic polishing of Stainless Steel and Alloys.

For full technical information write to

Metal Finishing Department
ALBRIGHT & WILSON (MFG) LTD
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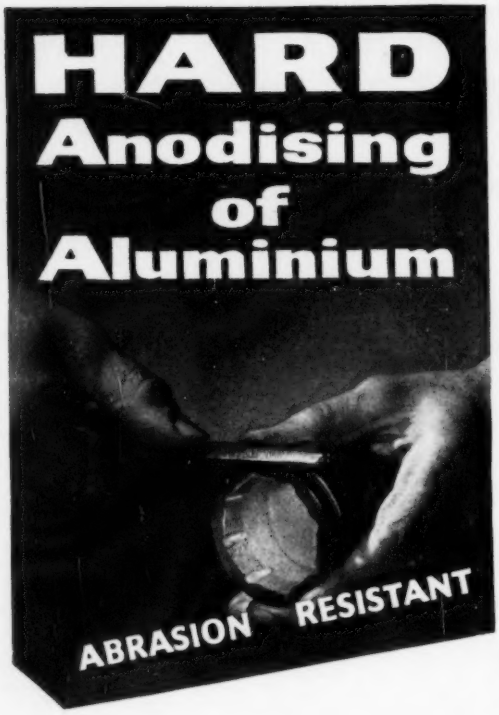

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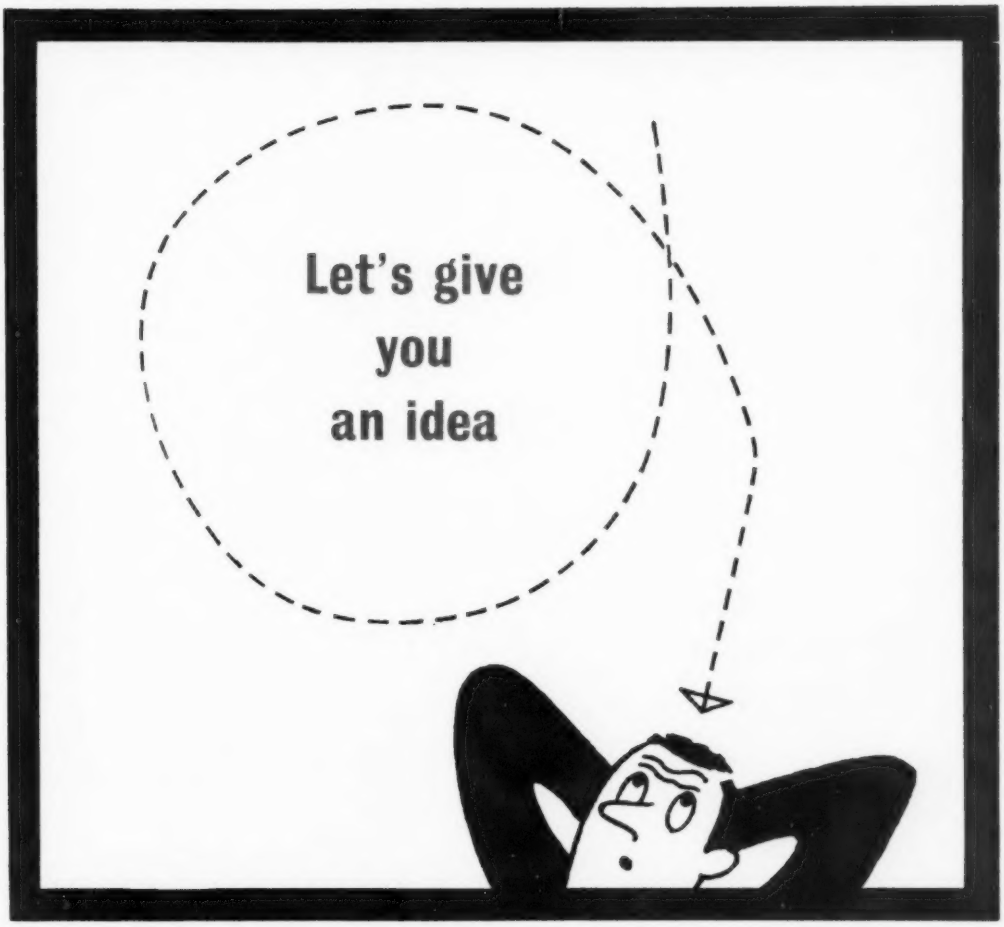

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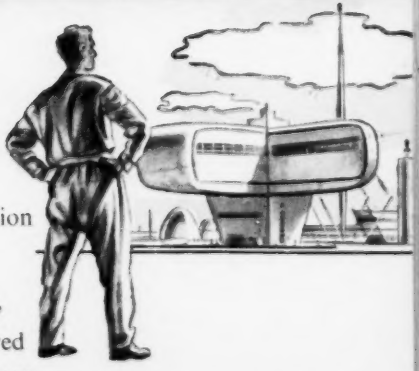

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